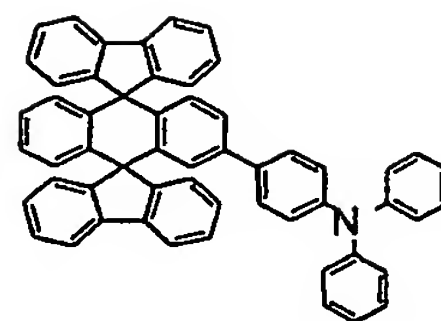
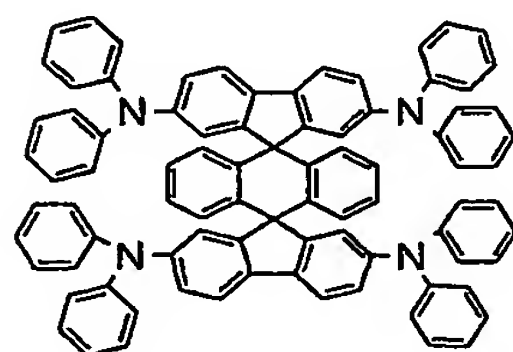


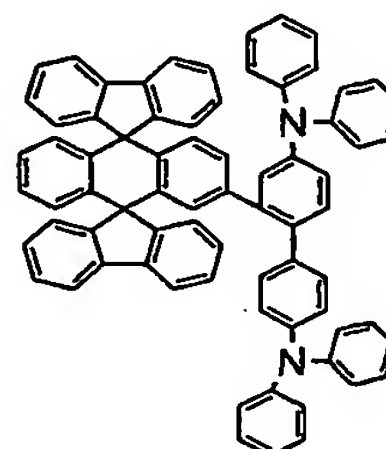
Chemical Compound 302



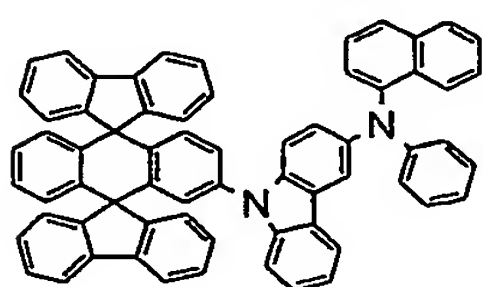
Chemical Compound 303



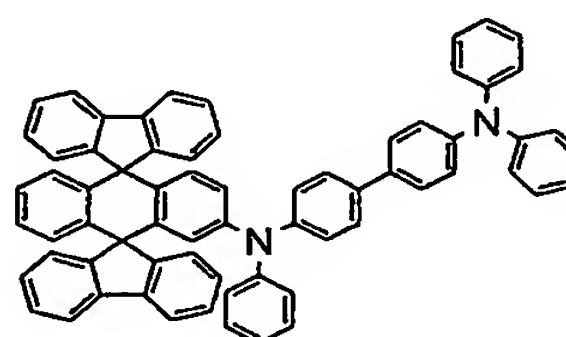
Chemical Compound 304



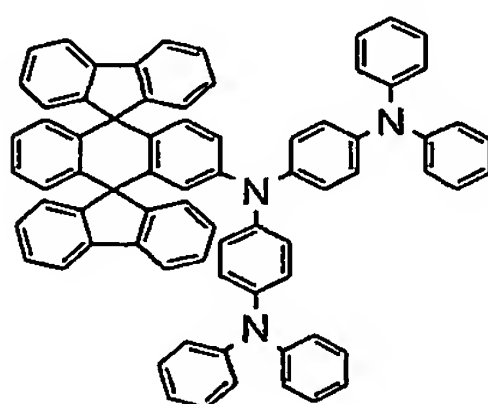
Chemical Compound 305



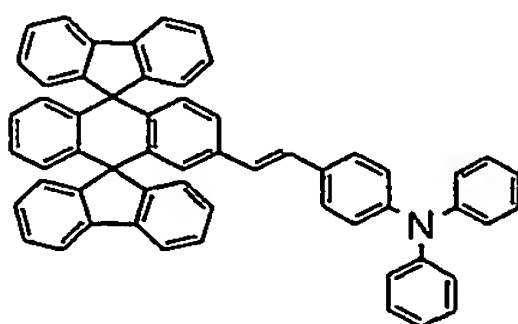
Chemical Compound 306



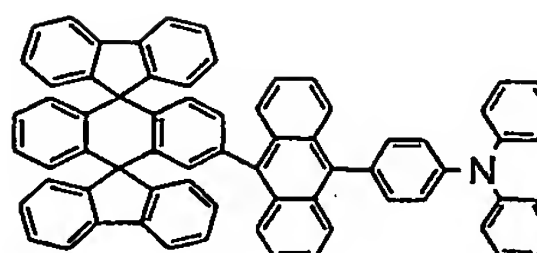
Chemical Compound 307



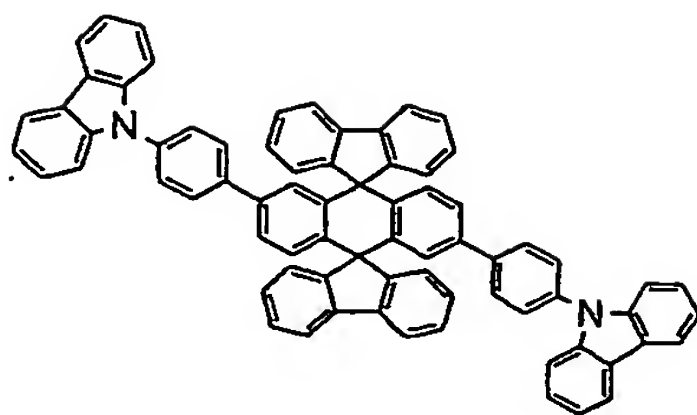
Chemical Compound 308



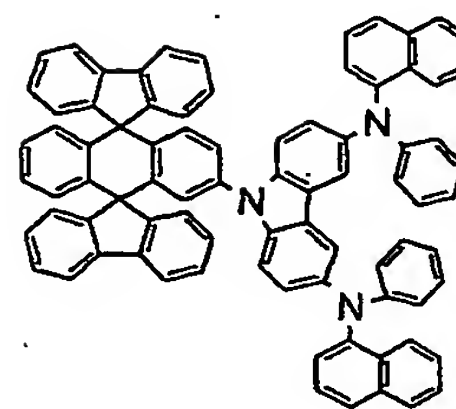
Chemical Compound 400



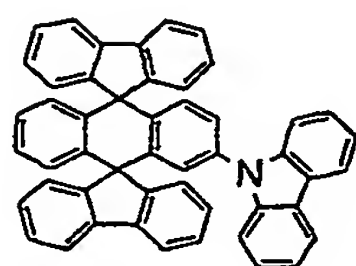
Chemical Compound 401



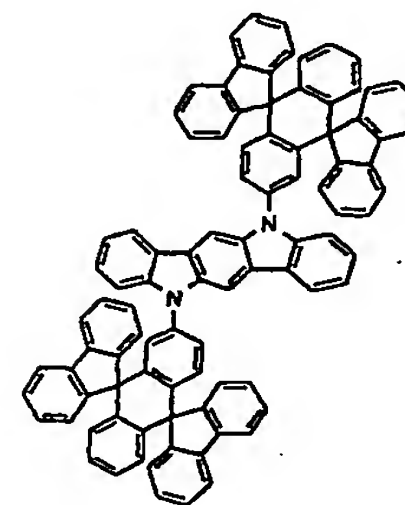
Chemical Compound 402



Chemical Compound 403

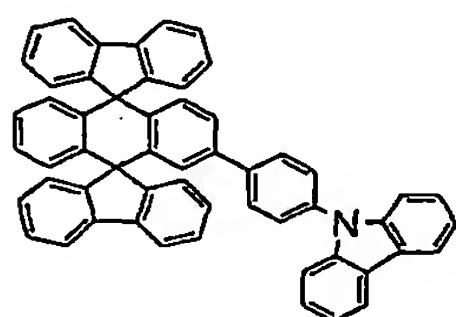


Chemical Compound 404

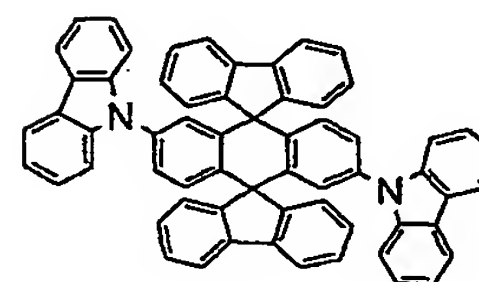


Chemical Compound 405

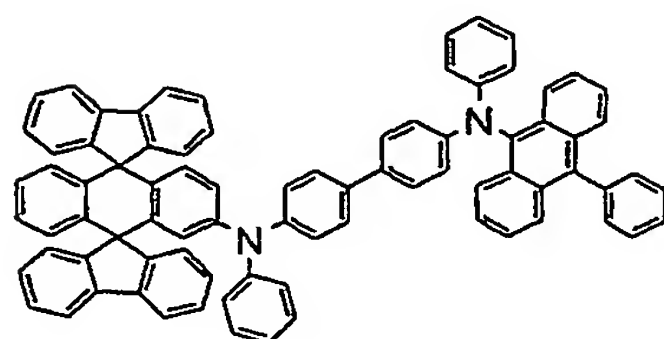
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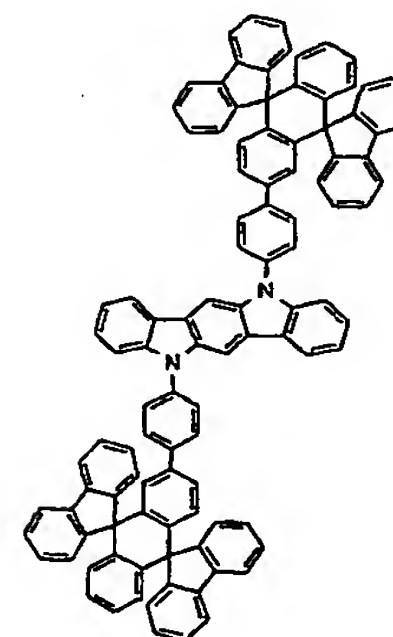
Chemical Compound 406



Chemical Compound 407

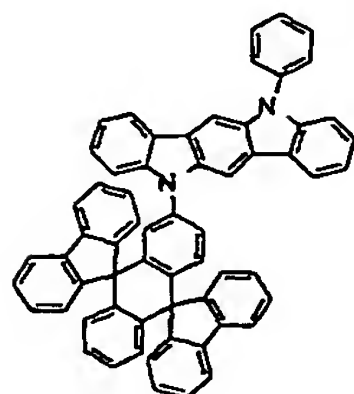


Chemical Compound 408

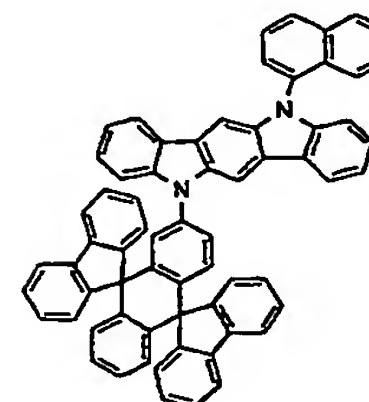


Chemical Compound 409

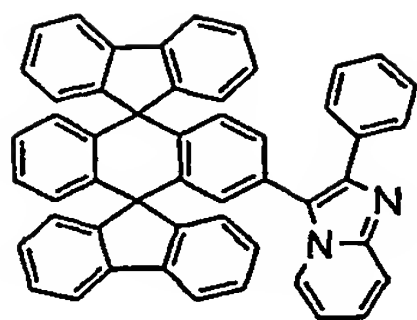
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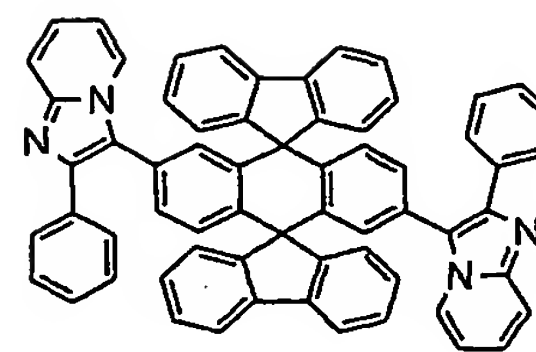
Chemical Compound 410



Chemical Compound 411



Chemical compound 412



Chemical Compound 413.

49. The solid deposition of Claim 29, wherein the one or more double-spiro compounds have a band gap corresponding to visible light emission.

5 50. The solid deposition of Claim 49, wherein the band-gap for the visible light emission is from about 1.8 eV to about 3.5 eV.

51. The solid deposition of Claim 49, wherein the band-gap corresponds to blue, green or red light emission.

10 52. The solid deposition of Claim 29, wherein the one or more double-spiro compounds have a hole-transporting property.

53. The solid deposition of Claim 29, wherein hole mobility in the one or more double-spiro compounds is about  $1 \times 10^{-7} \text{ cm}^2/\text{Vs}$  or greater.

54. The solid deposition of Claim 29, wherein the one or more double-spiro compounds have an electron-transporting property.

15 55. The solid deposition of Claim 29, wherein electron mobility in the one or more double-spiro compounds is about  $1 \times 10^{-7} \text{ cm}^2/\text{Vs}$  or greater.

56. The solid deposition of Claim 29, wherein the one or more double-spiro compounds have a hole-injecting property.

20 57. The solid deposition of Claim 29, wherein the one or more double-spiro compounds have the highest occupied molecular orbital (HOMO) level from about -4.0 eV to about 6.0 eV.

58. The solid deposition of Claim 29, wherein the one or more double-spiro compounds have an electron-injecting property.

25 59. The solid deposition of Claim 29, wherein the one or more double-spiro compounds has the lowest unoccupied molecular orbital (LUMO) level from about -2.5 eV to about 4.0 eV.

30 60. A method of making the solid deposition of Claim 29, comprising:  
providing a support; and  
depositing one or more chemical compounds comprising one or  
more of the double-spiro compounds.

61. The method of Claim 60, wherein the depositing one or more chemical compounds comprises physical vapor deposition.

62. The method of Claim 60, wherein the depositing one or more chemical compounds comprises forming multiple layers of different compositions of the one or more chemical compounds.

63. An organic electroluminescent ("EL") device comprising:  
an anode;  
a cathode; and

the solid deposition of Claim 29 located between the anode and cathode, wherein the solid deposition comprises one or more layers comprising a light-emitting layer.

64. The organic EL device of Claim 63, wherein the light-emitting layer comprises the one or more double-spiro compounds having the band gap corresponding to visible light emission.

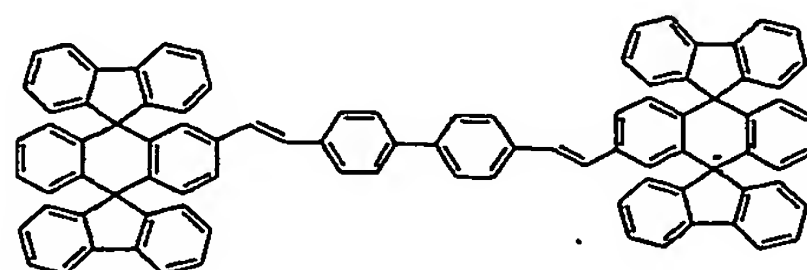
65. The organic EL device of Claim 64, wherein the band-gap for the visible light emission is from about 1.8 eV to about 3.5 eV.

66. The organic EL device of Claim 63, wherein the light-emitting layer comprises one or more fluorescent or phosphorescent materials.

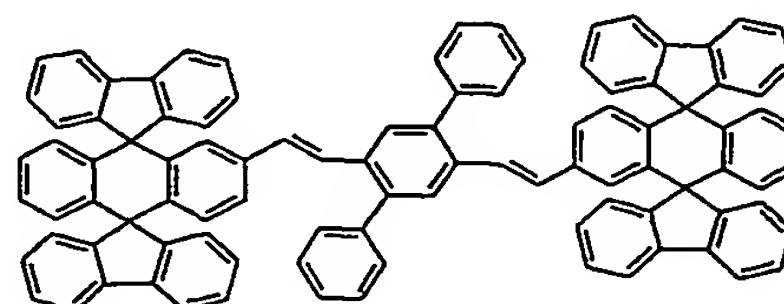
67. The organic EL device of Claim 63, wherein the organic EL device is supported by a substrate, and wherein the substrate contacts either the anode or the cathode.

68. The organic EL device of Claim 63, wherein the one or more layers comprise at least one material having one or more properties selected from the group consisting of electron injection, electron transportation, light emission, hole transportation, and hole injection.

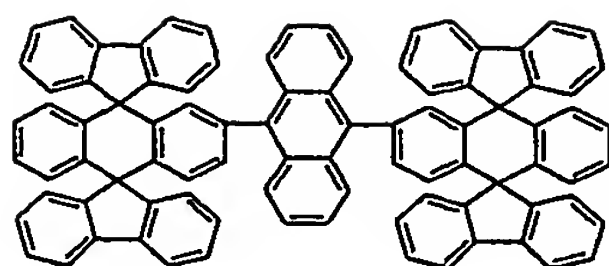
69. The organic EL device of Claim 63, wherein the light-emitting layer comprises one or more selected from the group consisting of Chemical Compounds 100-137, 200-222, and 400-413 as shown below:



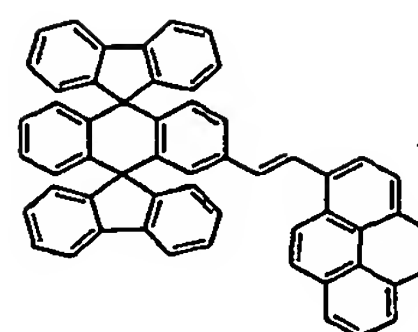
Chemical Compound 100



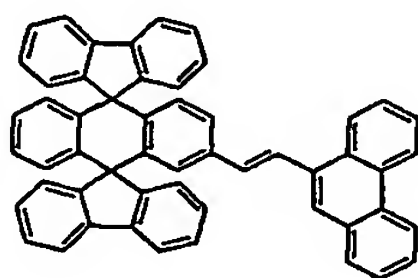
Chemical Compound 101



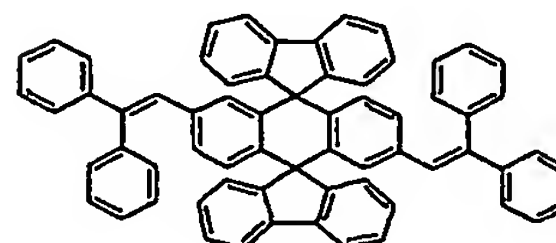
Chemical Compound 102



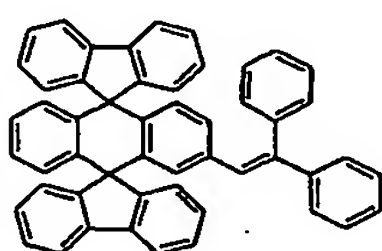
Chemical Compound 103



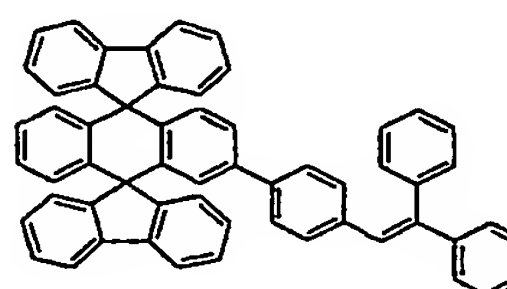
Chemical Compound 104



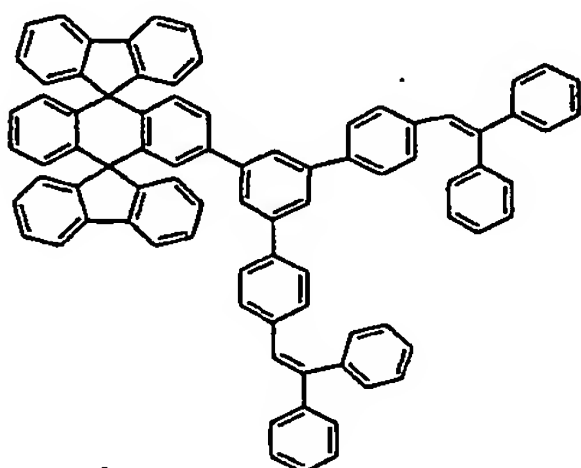
Chemical Compound 105



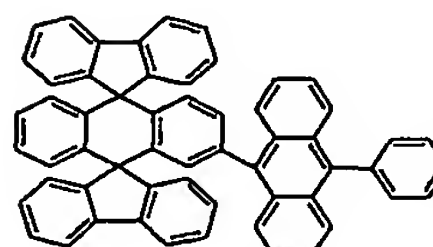
Chemical Compound 106



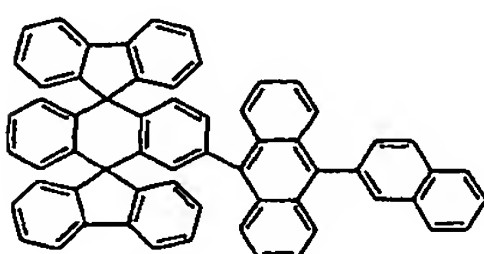
Chemical Compound 107



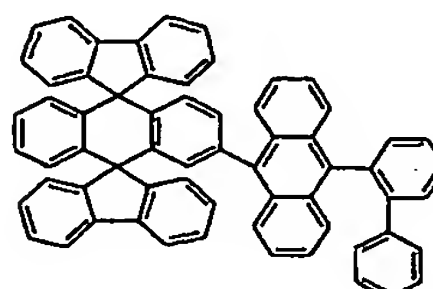
Chemical Compound 108



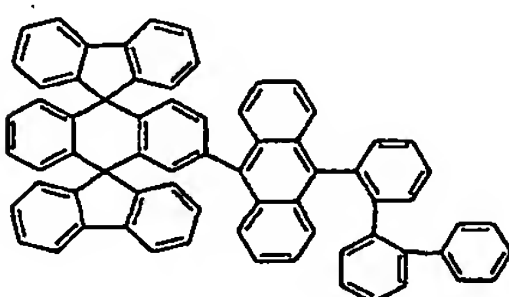
Chemical Compound 109



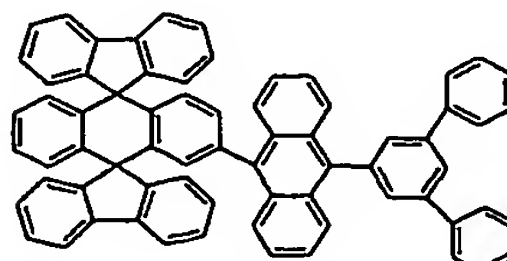
Chemical Compound 110



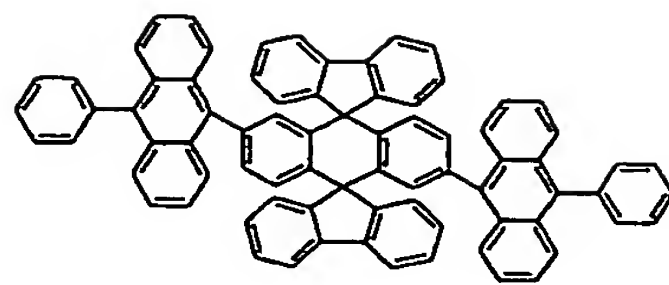
Chemical Compound 111



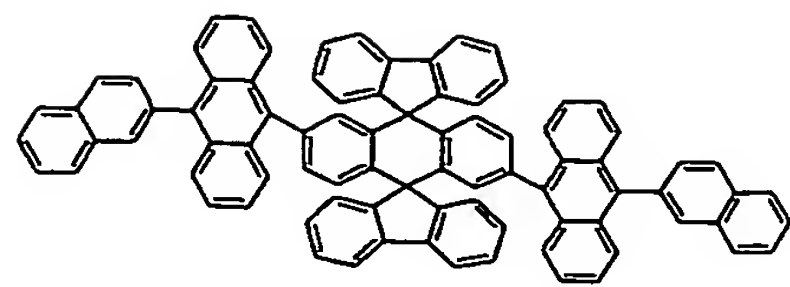
Chemical Compound 112



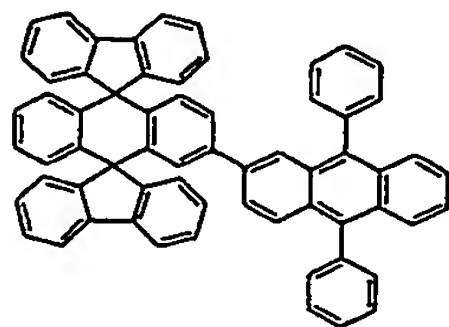
Chemical Compound 113



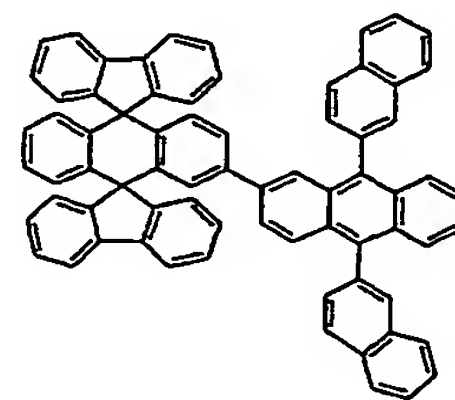
Chemical Compound 114



Chemical Compound 115

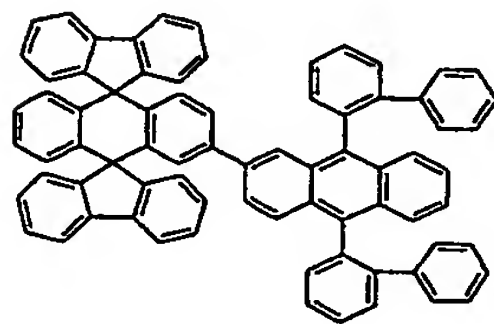


Chemical Compound 116

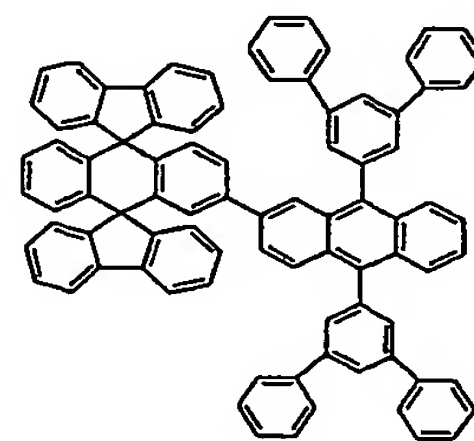


Chemical Compound 117

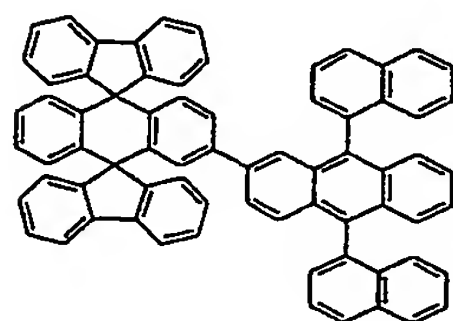
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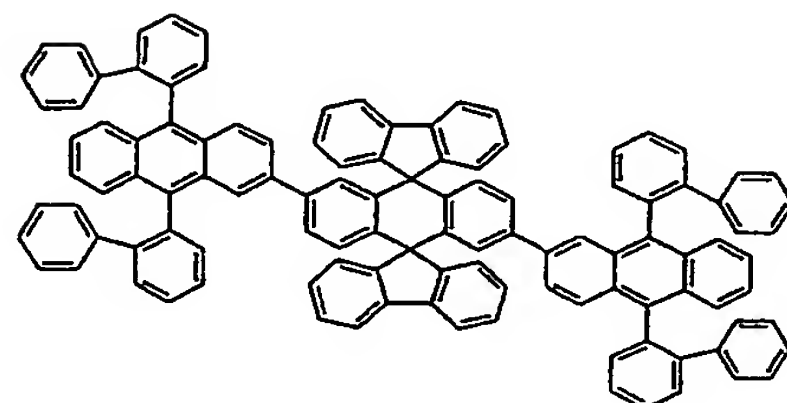
Chemical Compound 118



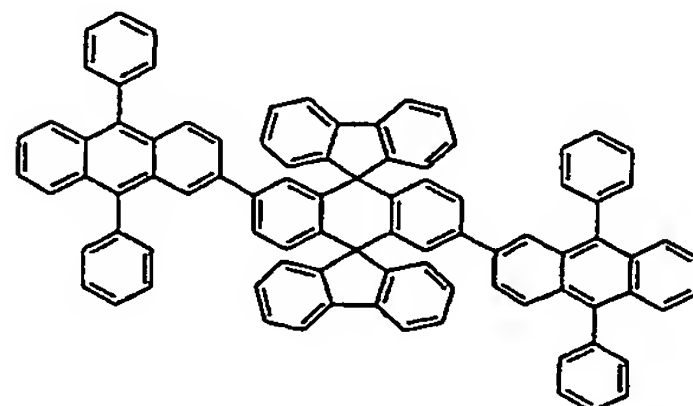
Chemical Compound 119



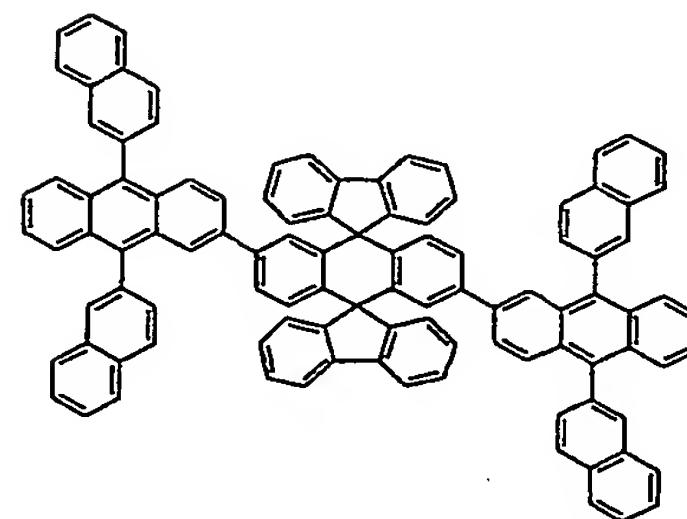
Chemical Compound 120



Chemical Compound 121

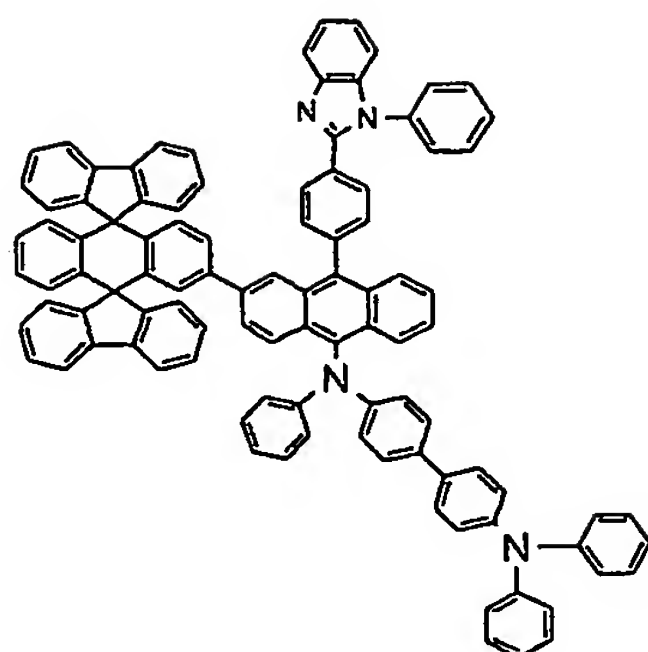


Chemical Compound 122

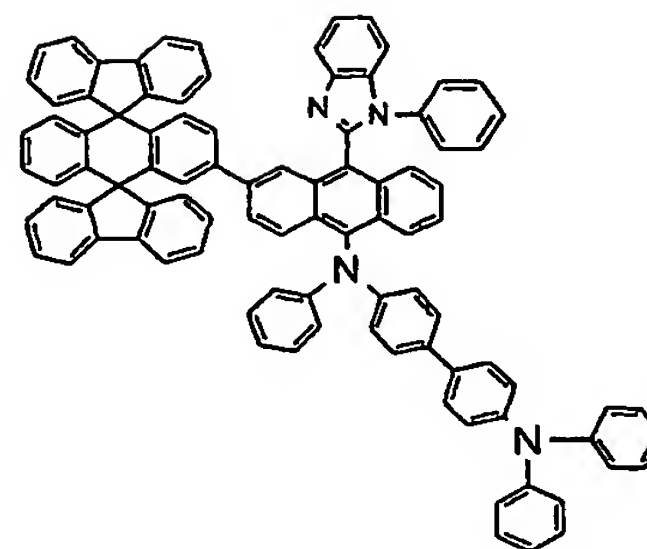


Chemical Compound 123

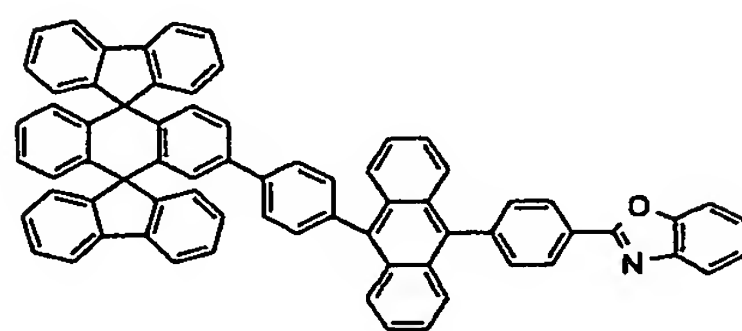
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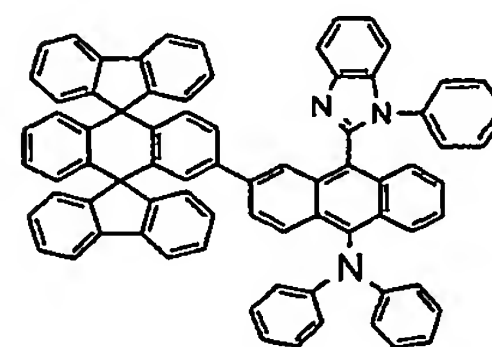
Chemical Compound 124



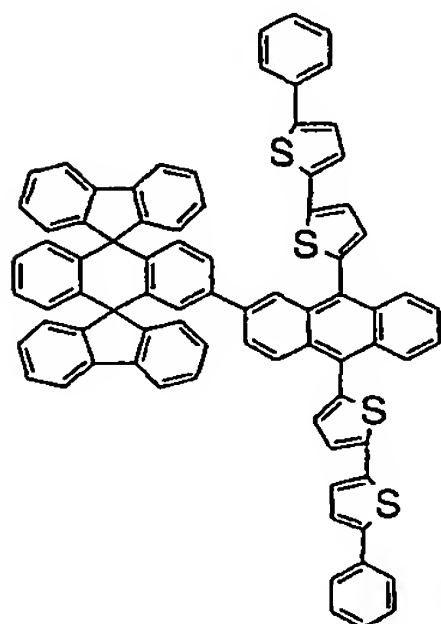
Chemical Compound 125



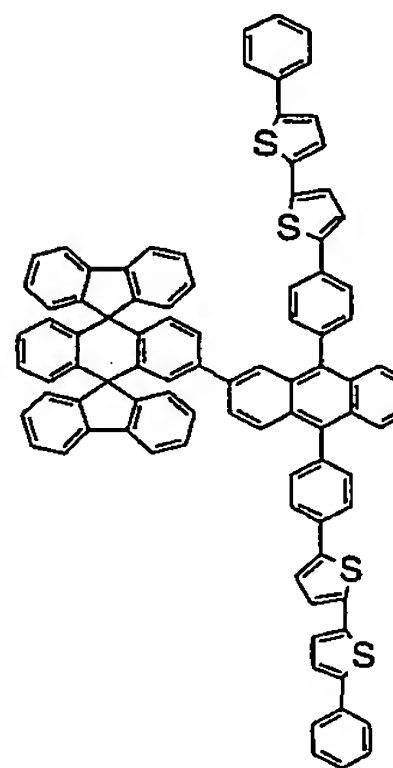
Chemical Compound 126



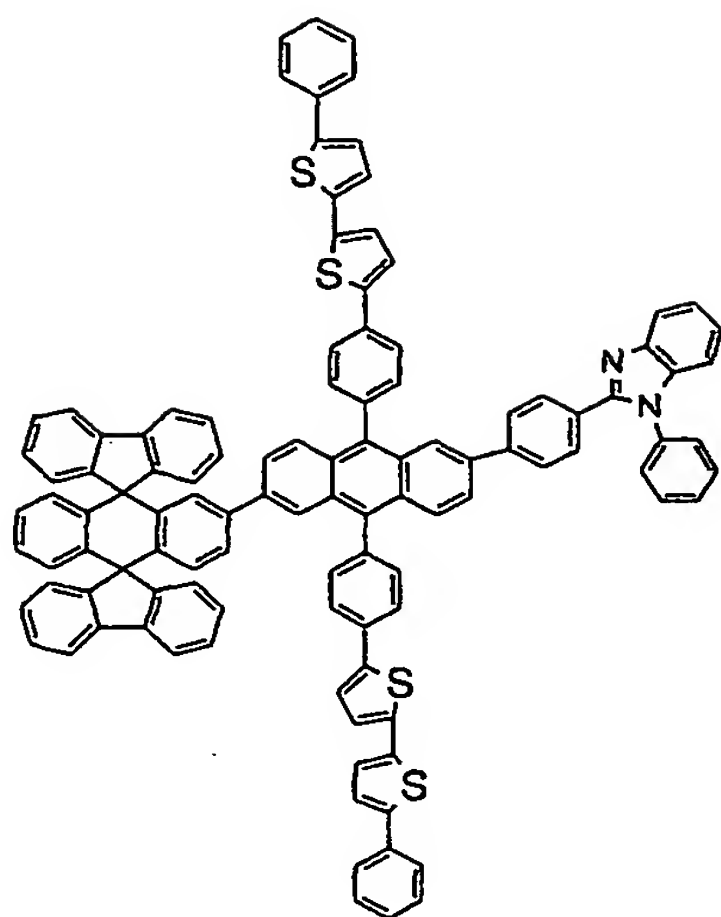
Chemical Compound 127



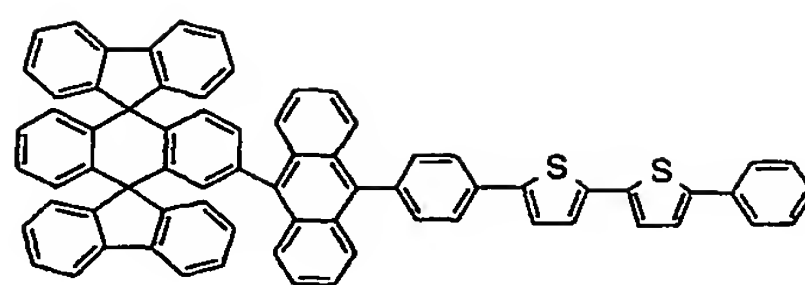
Chemical Compound 128



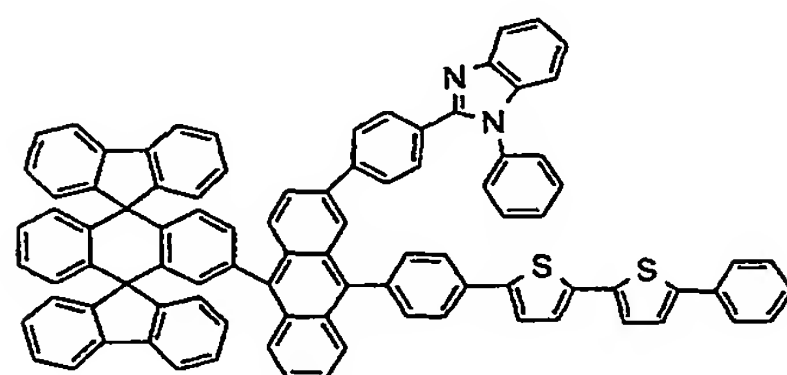
Chemical Compound 129



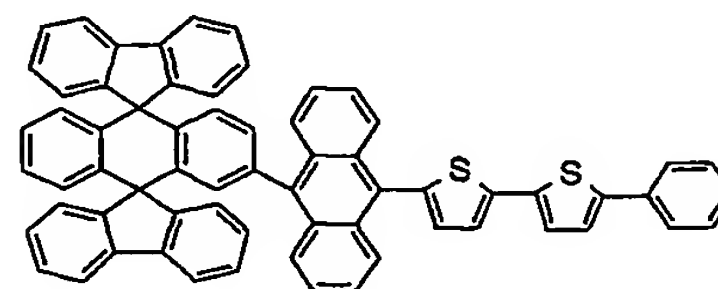
Chemical Compound 130



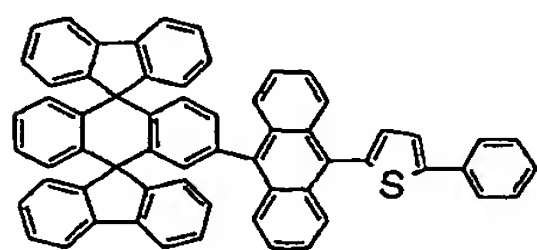
Chemical Compound 131



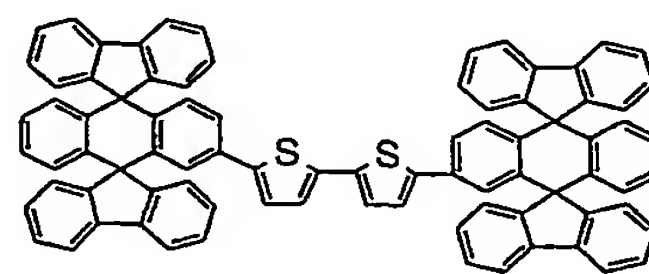
Chemical Compound 132



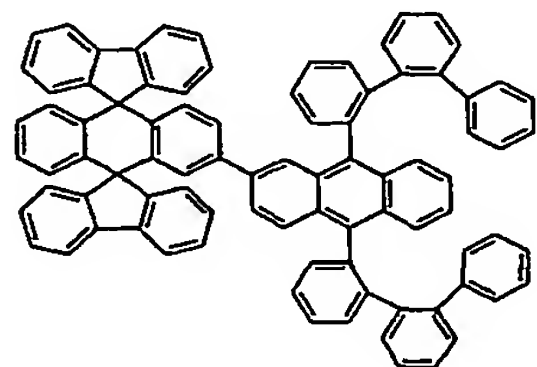
Chemical Compound 133



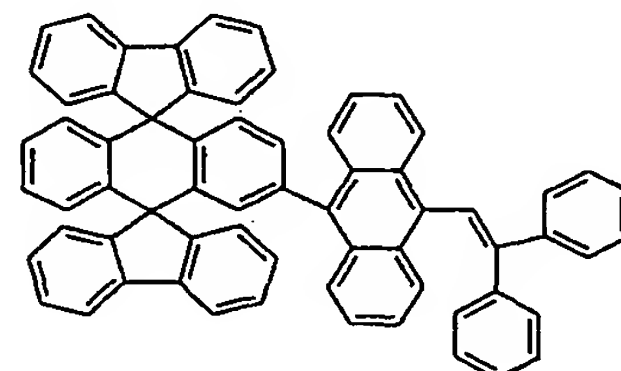
Chemical Compound 134



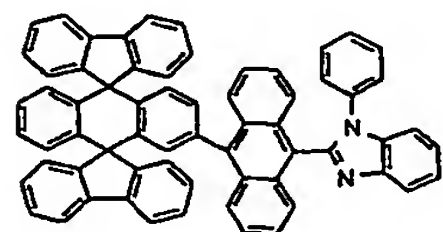
Chemical Compound 135



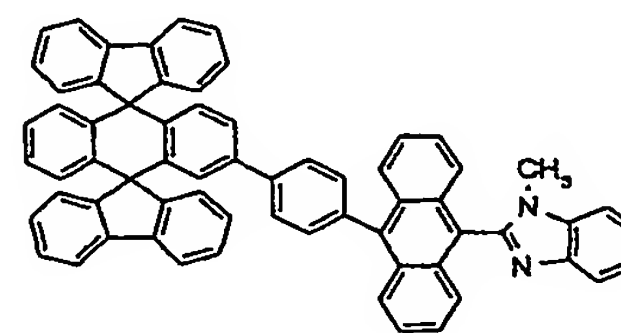
Chemical Compound 136



Chemical Compound 137



Chemical Compound 200

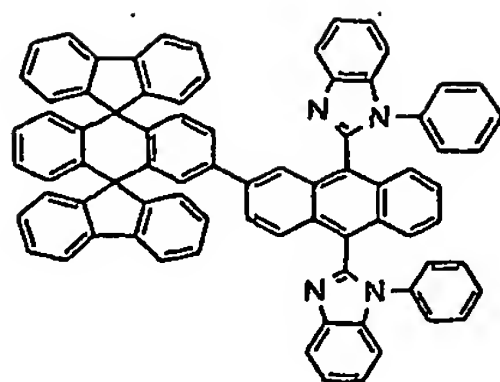


Chemical Compound 201

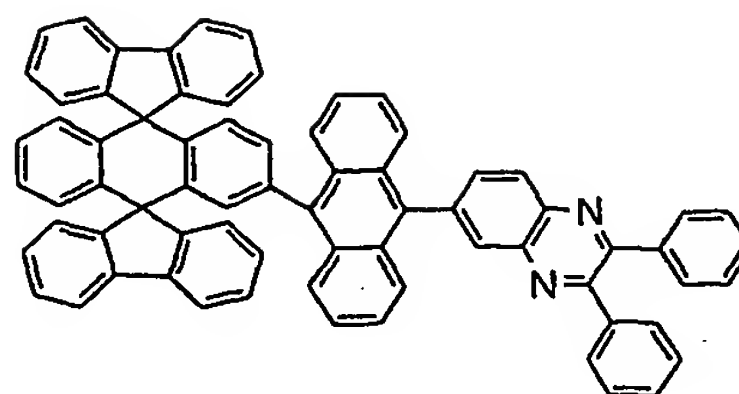
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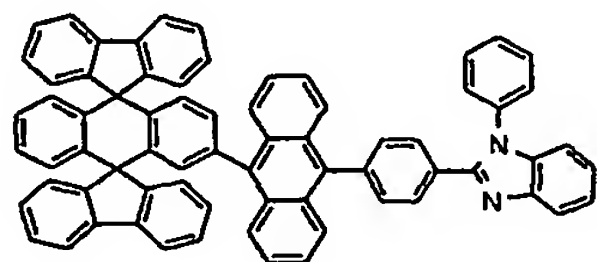




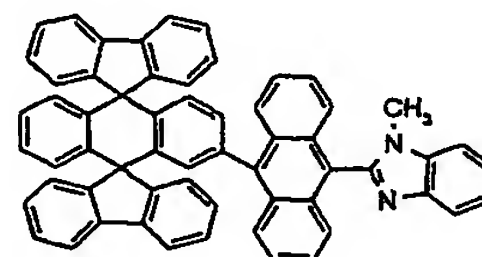
Chemical Compound 202



Chemical Compound 203

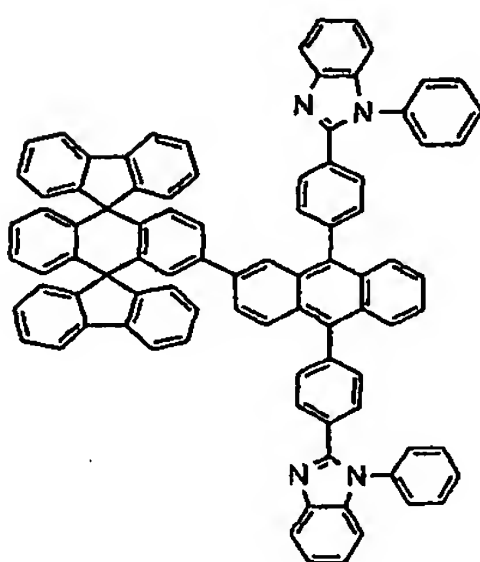


Chemical Compound 204

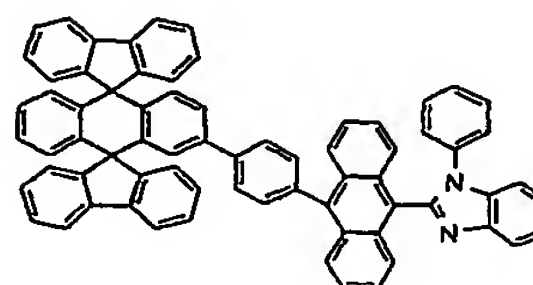


Chemical Compound 205

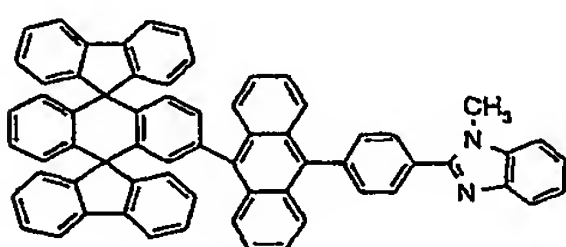
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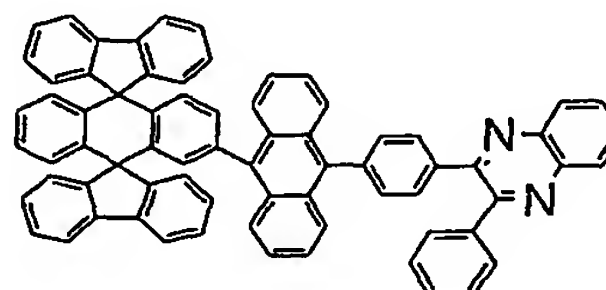
Chemical Compound 206



Chemical Compound 207

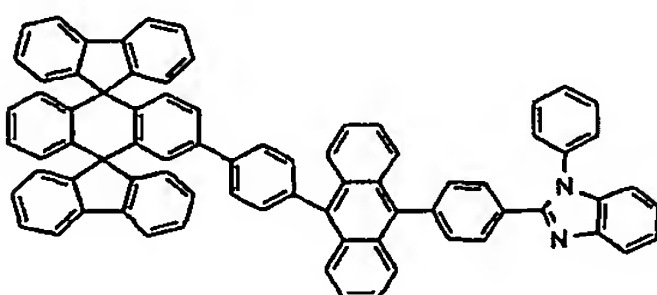


Chemical Compound 208

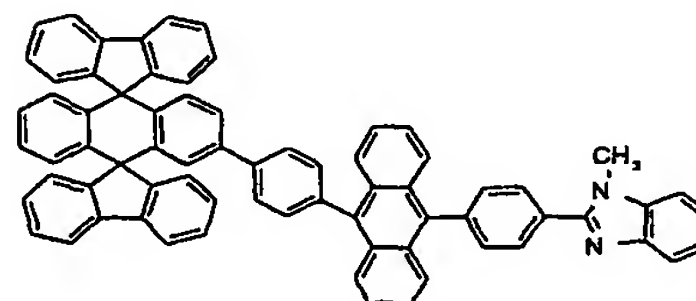


Chemical Compound 209

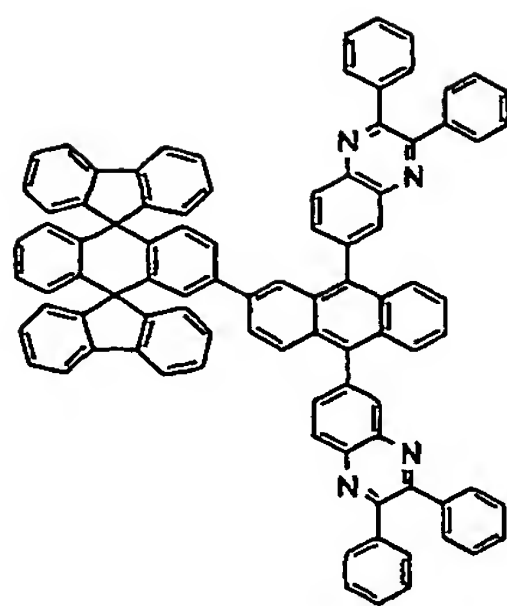
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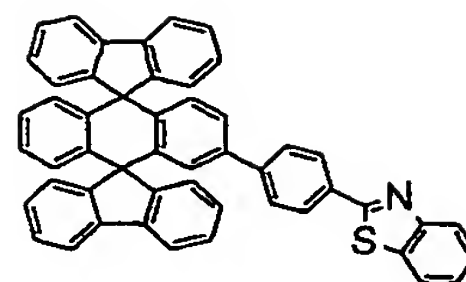
Chemical Compound 210



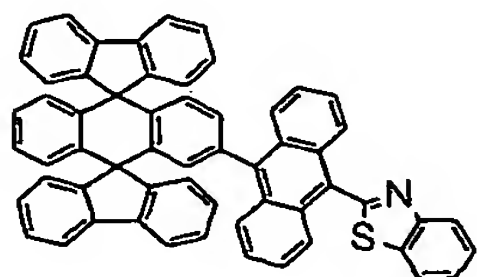
Chemical Compound 211



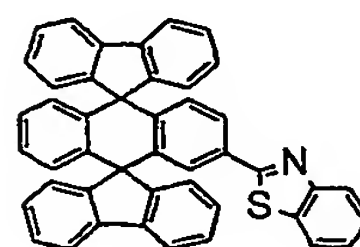
Chemical Compound 212



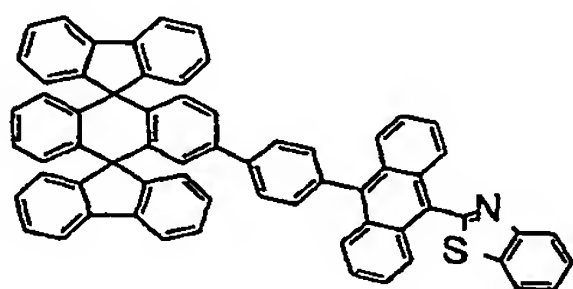
Chemical Compound 213



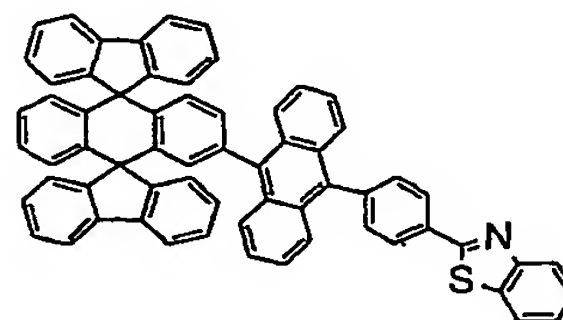
Chemical Compound 214



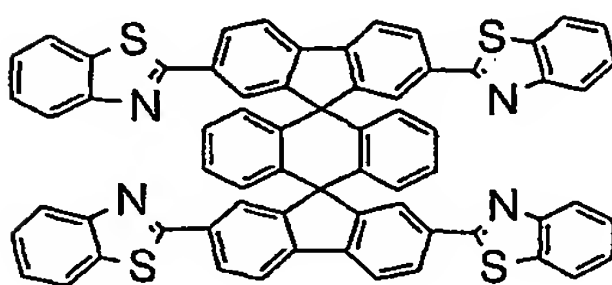
Chemical Compound 215



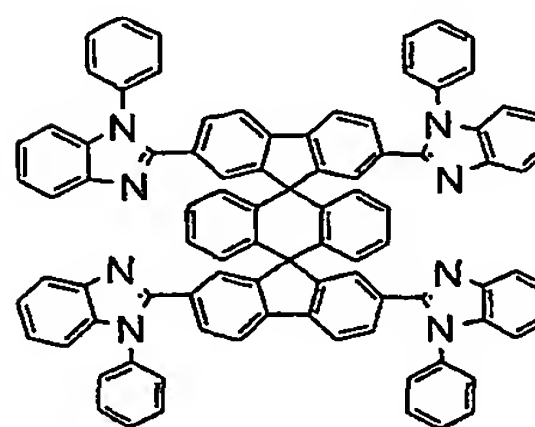
Chemical Compound 216



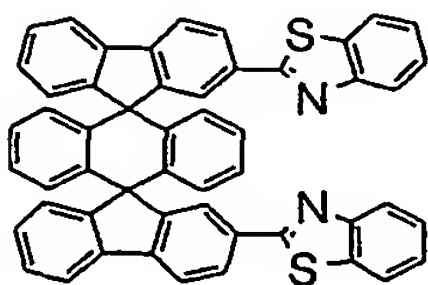
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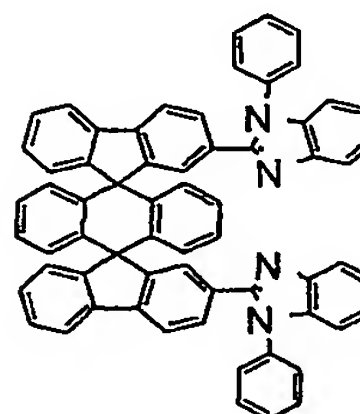
Chemical Compound 218



Chemical Compound 219



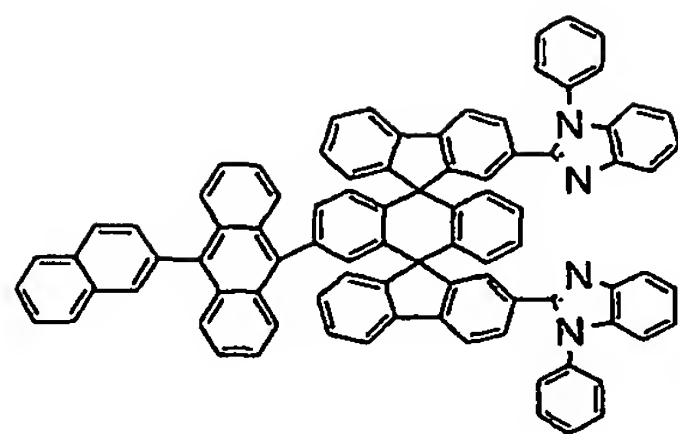
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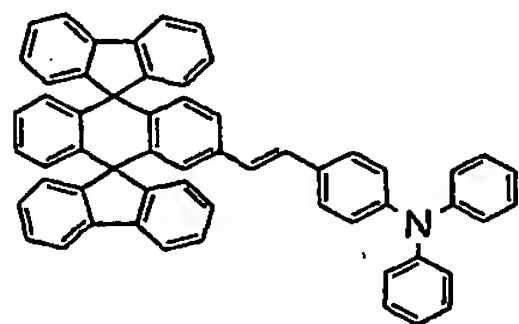
Chemical Compound 221

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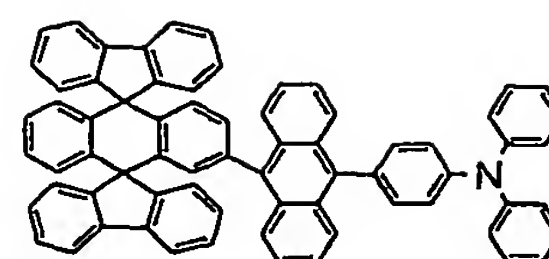
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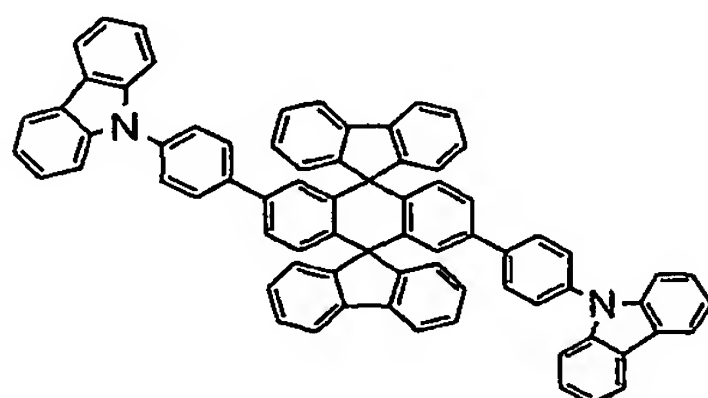
Chemical Compound 222



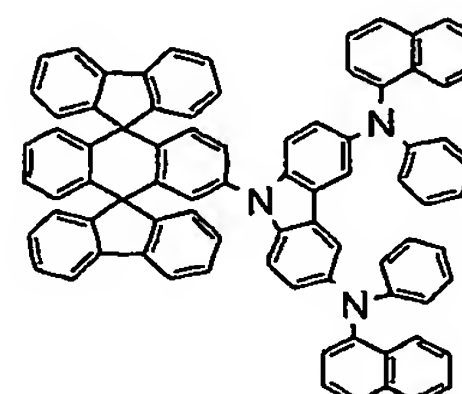
Chemical Compound 400



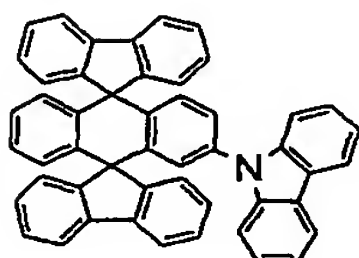
Chemical Compound 401



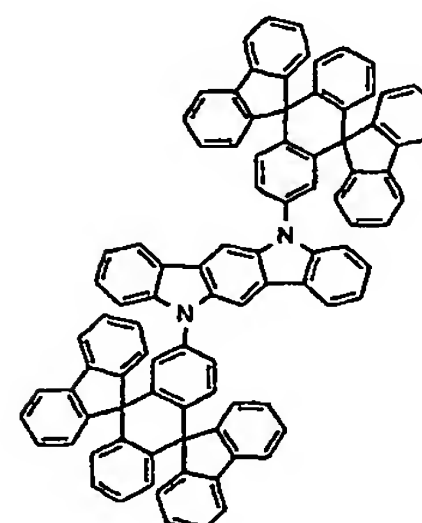
Chemical Compound 402



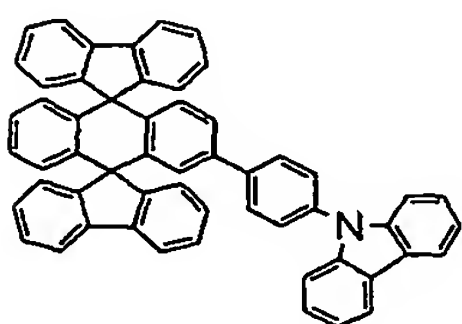
Chemical Compound 403



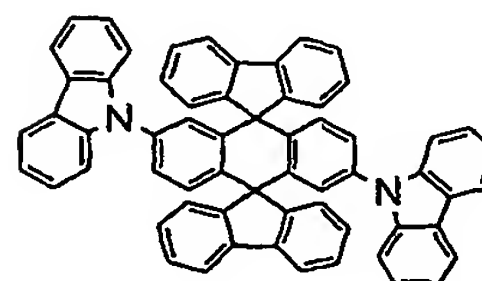
Chemical Compound 404



Chemical Compound 405



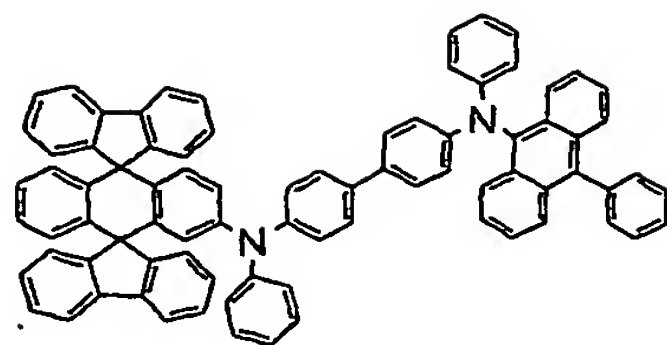
Chemical Compound 406



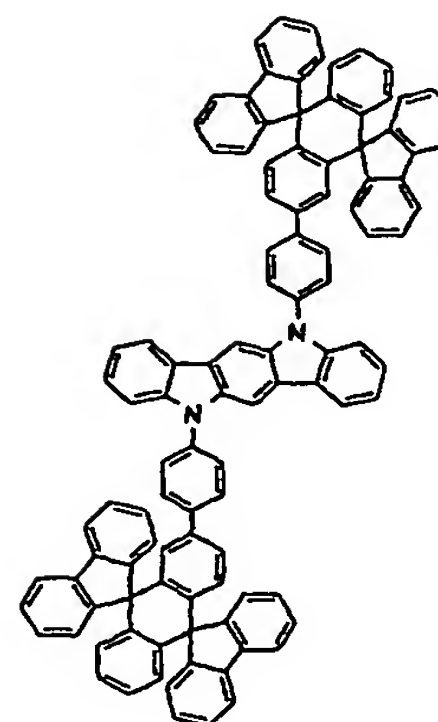
Chemical Compound 407

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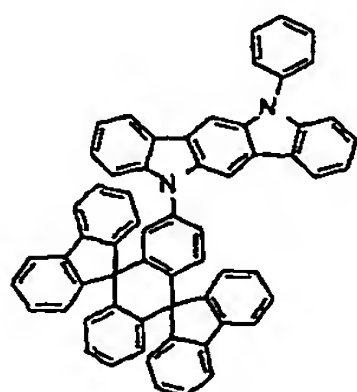
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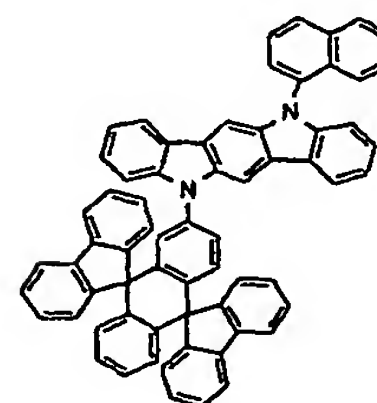
Chemical Compound 408



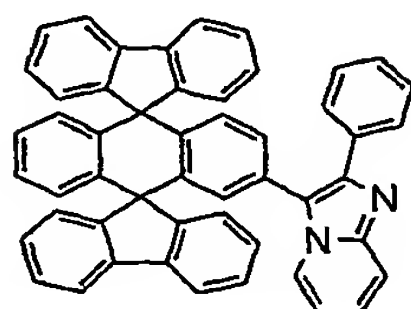
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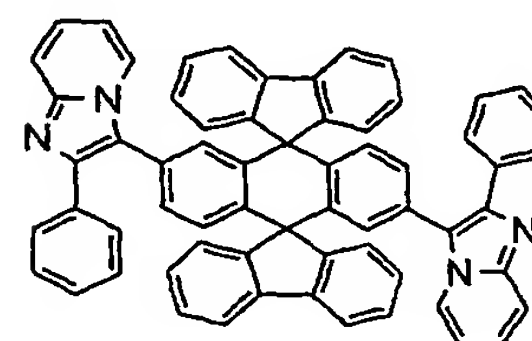
Chemical Compound 410



Chemical Compound 411



Chemical compound 412



Chemical Compound 413.

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70. The organic EL device of Claim 69, wherein the light-emitting layer further comprises one or more non-double-spiro light-emitting compounds.

71. The organic EL device of Claim 70, wherein the non-double-spiro light-emitting compound has the band gap smaller than the band gap of the double-spiro compound.

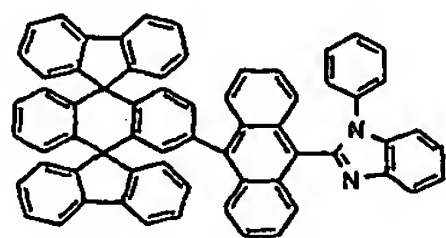
72. The organic EL device of Claim 70, wherein the non-double-spiro light-emitting compound has the band gap greater than the band gap of the double-spiro compound.

73. The organic EL device of Claim 70, wherein the non-double-spiro light-emitting compound is either fluorescent or phosphorescent compound.

74. The organic EL device of Claim 63, wherein the one or more layers comprise at least one of the electron-injecting and electron-transporting layers.

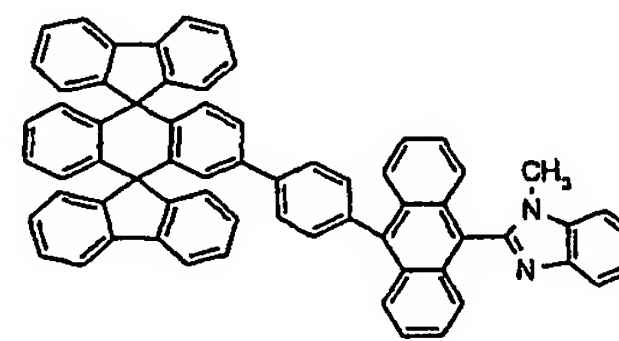
15

75. The organic EL device of Claim 74, wherein the at least one of the electron-injecting and electron-transporting layers comprises Chemical Compounds 200-222 as shown below:

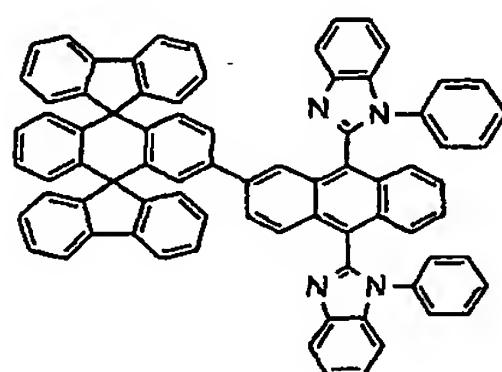


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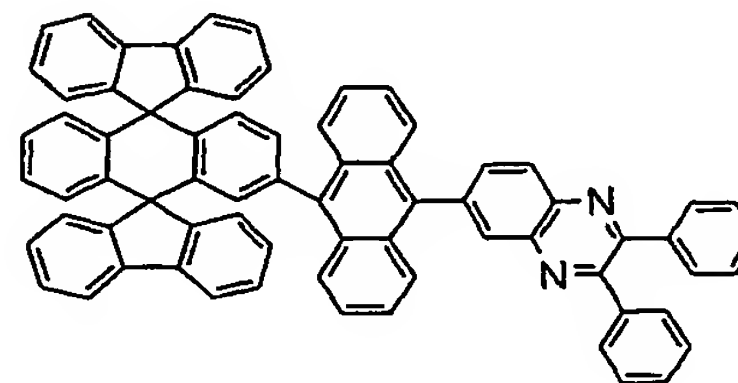
Chemical Compound 200



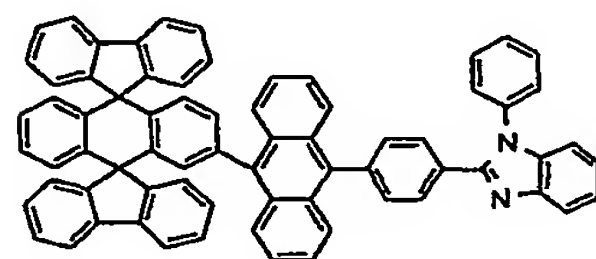
Chemical Compound 201



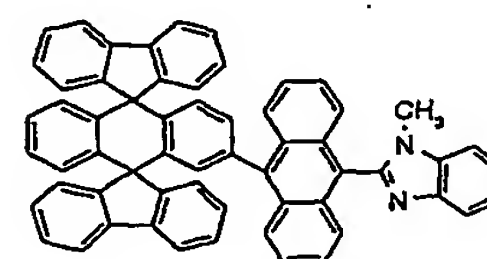
Chemical Compound 202



Chemical Compound 203

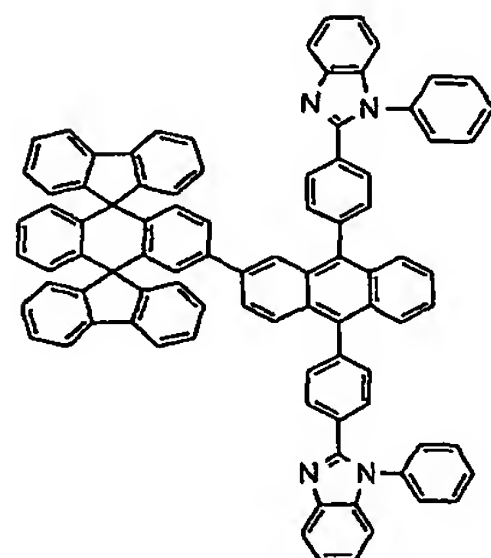


Chemical Compound 204

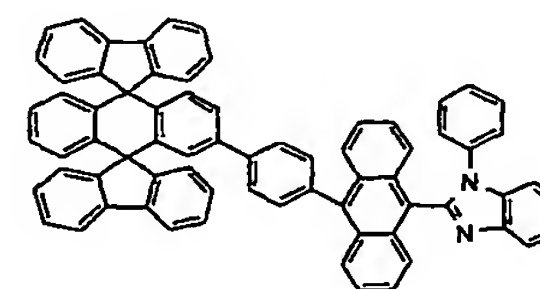


Chemical Compound 205

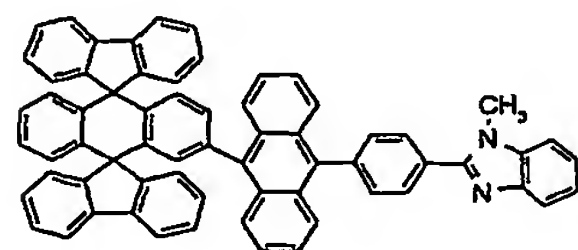
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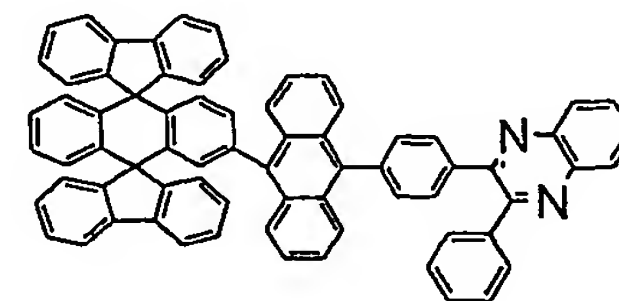
Chemical Compound 206



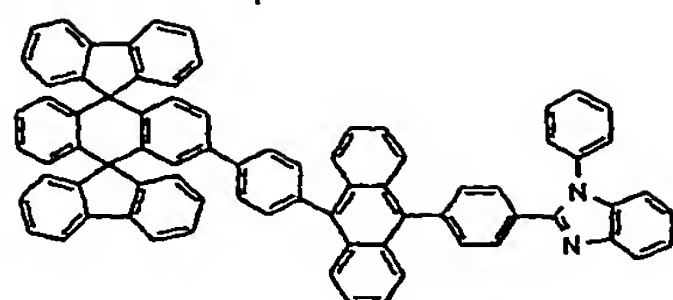
Chemical Compound 207



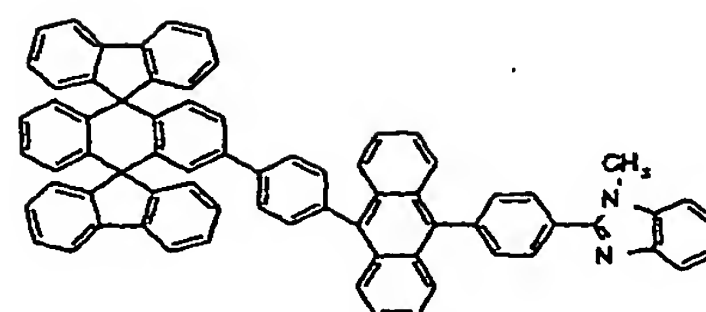
Chemical Compound 208



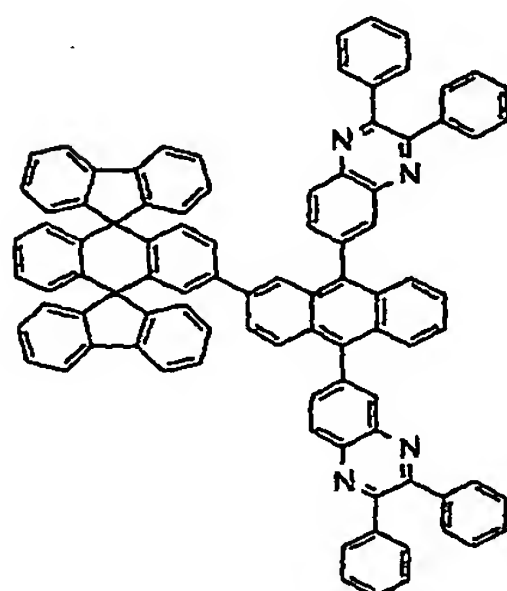
Chemical Compound 209



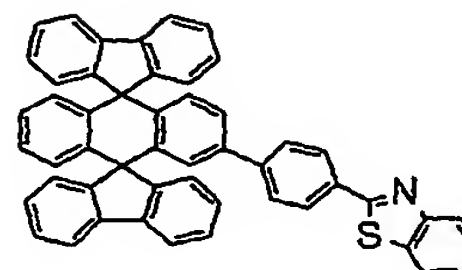
Chemical Compound 210



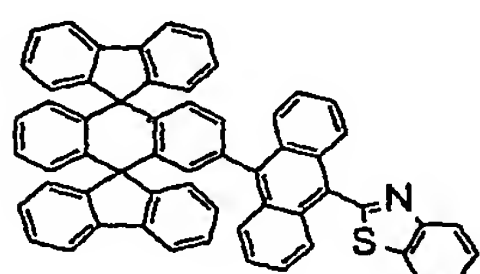
Chemical Compound 211



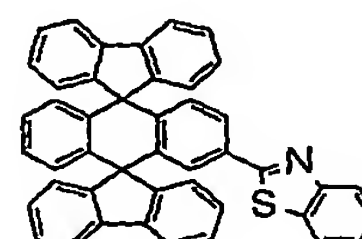
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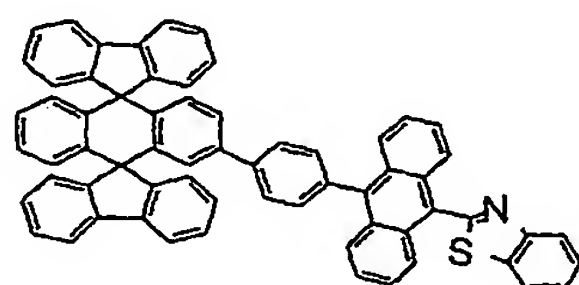
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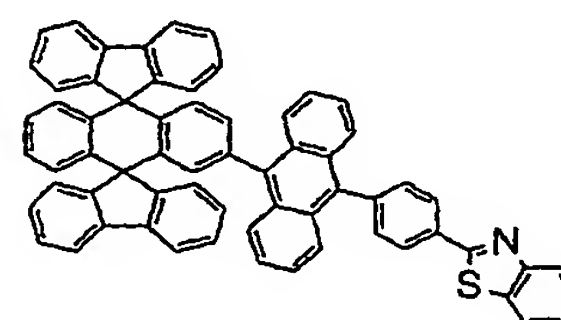
Chemical Compound 214



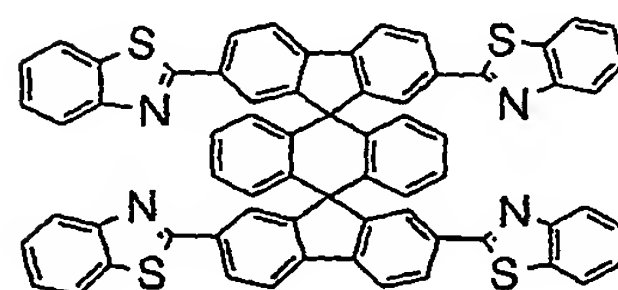
Chemical Compound 215



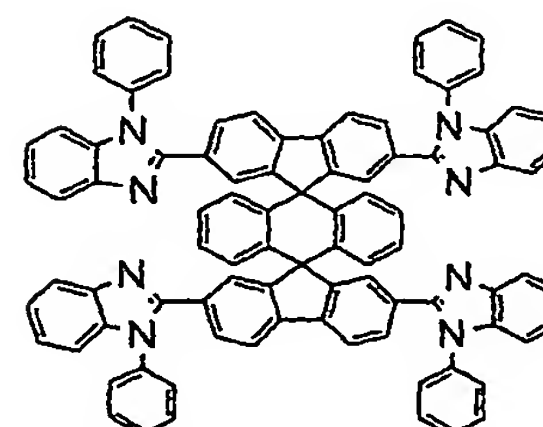
Chemical Compound 216



Chemical Compound 217



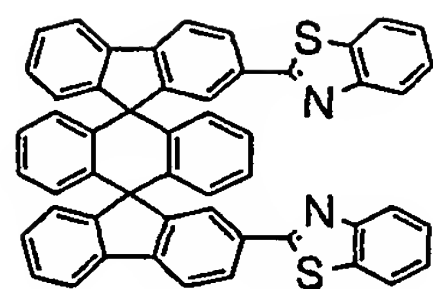
Chemical Compound 218



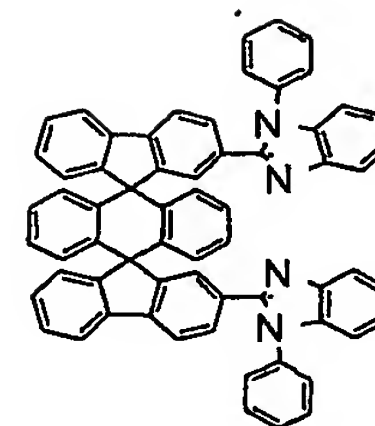
Chemical Compound 219

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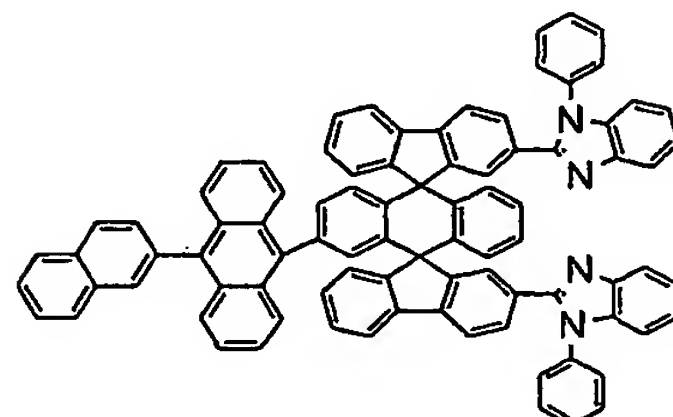
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Chemical Compound 220



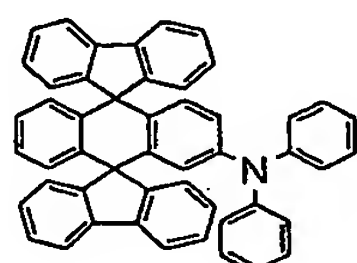
Chemical Compound 221



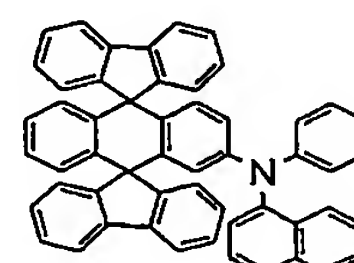
Chemical Compound 222.

5            76.    The organic EL device of Claim 63, wherein the one or more layers comprise at least one of the hole-injecting and hole-transporting layers.

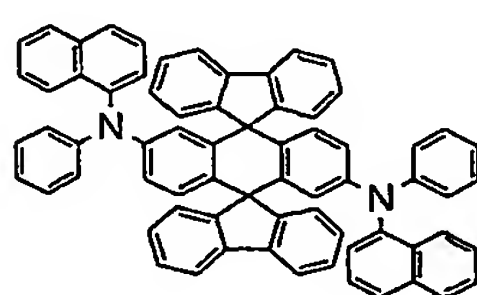
77.    The organic EL device of Claim 76, wherein the at least one of the hole-injecting and hole-transporting layers comprises Chemical Compounds 300-308 and 400-413 as shown below:



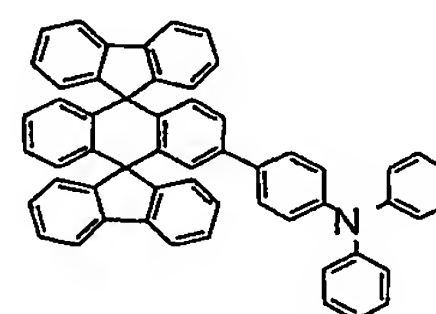
Chemical Compound 300



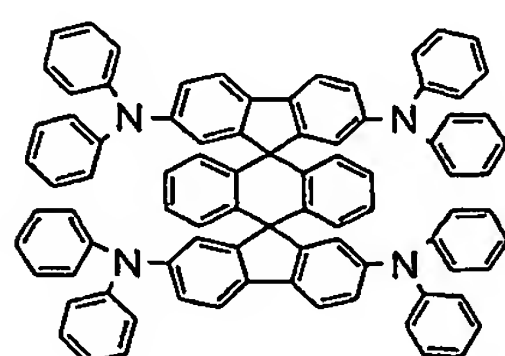
Chemical Compound 301



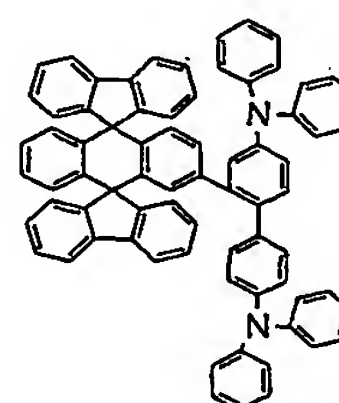
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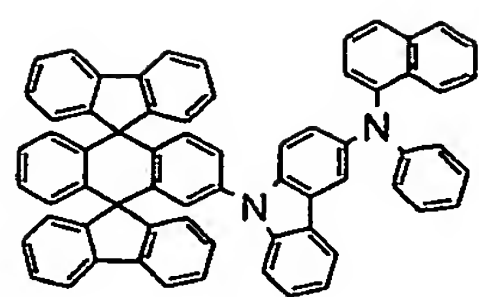
Chemical Compound 303



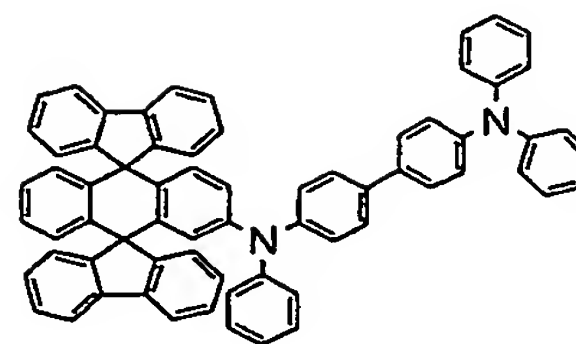
Chemical Compound 304



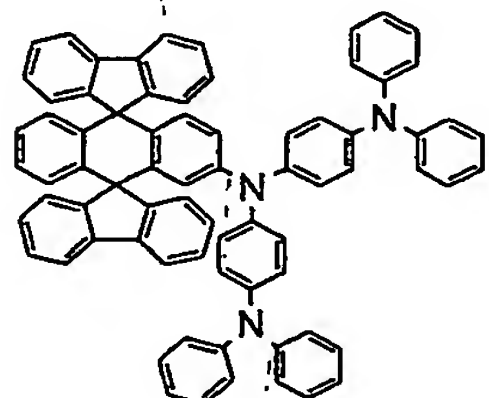
Chemical Compound 305



Chemical Compound 306

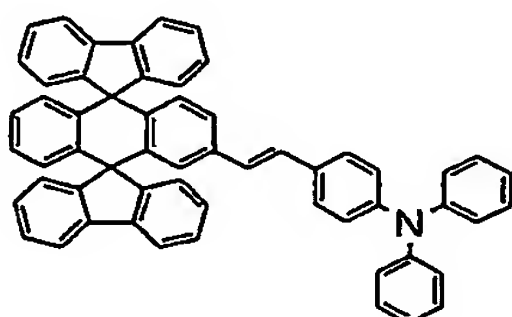


Chemical Compound 307

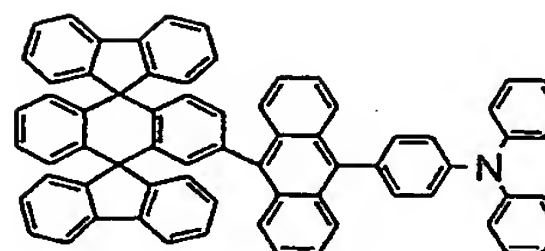


Chemical Compound 308

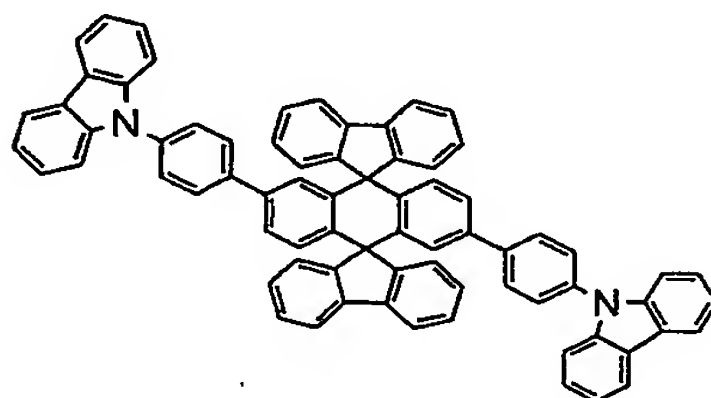
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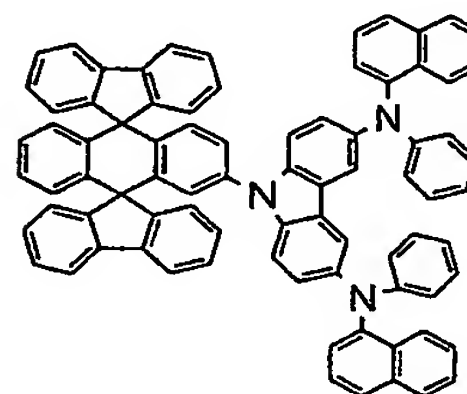
Chemical Compound 400



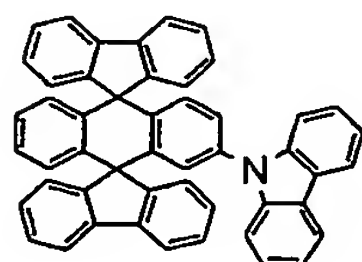
Chemical Compound 401



Chemical Compound 402

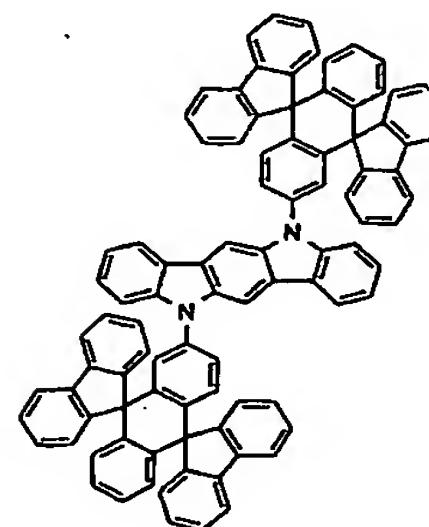


Chemical Compound 403



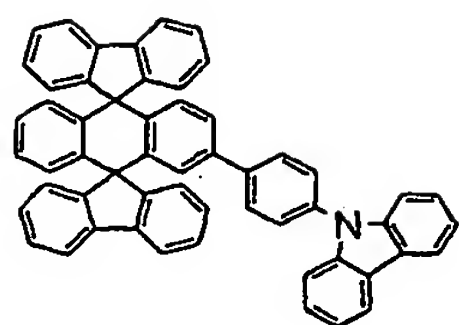
Chemical Compound 404

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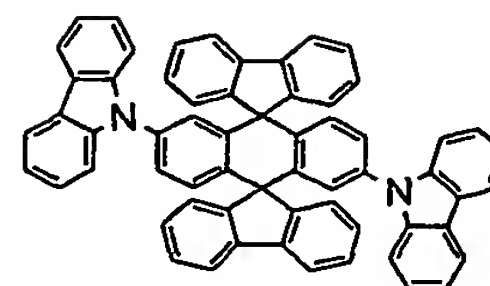


Chemical Compound 405

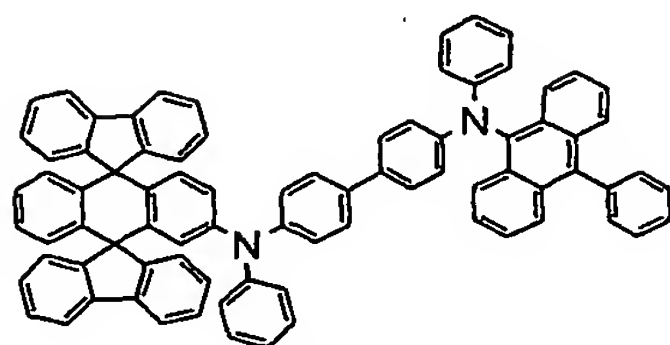




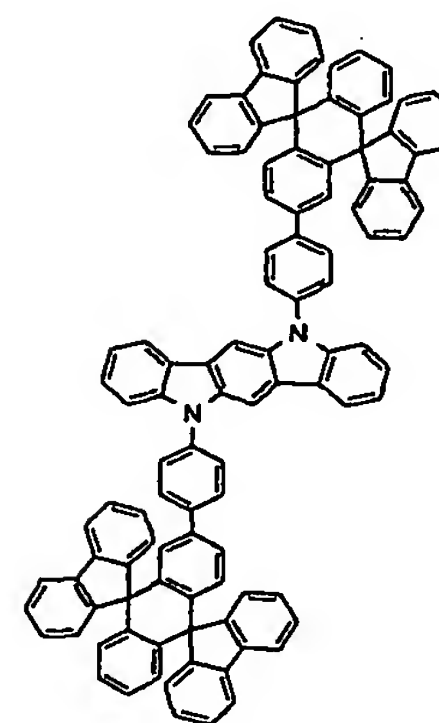
Chemical Compound 406



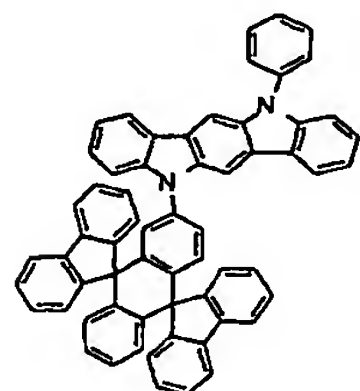
Chemical Compound 407



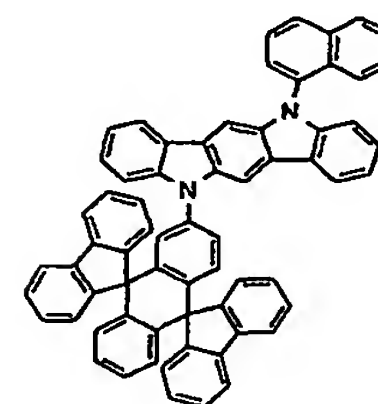
Chemical Compound 408



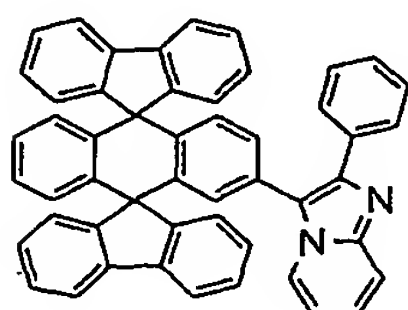
Chemical Compound 409



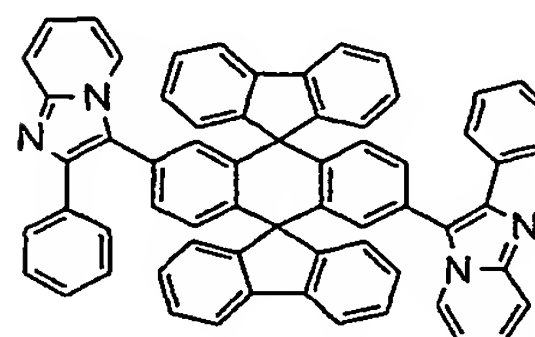
Chemical Compound 410



Chemical Compound 411



Chemical compound 412



Chemical Compound 413.

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78. An electronic device comprising a display, wherein the display comprises the organic EL device of Claim 63.

79. A method of generating visible light from the organic EL device of Claim 63, comprising:

15

applying electric power between the anode and cathode of the device;

the cathode injecting electrons toward the light-emitting layer;

the anode injecting holes toward the light-emitting layer; and

allowing recombination of at least part of the injected electrons and holes in the light-emitting layer, thereby generating visible light from the light-emitting layer.

80. The method of Claim 79, wherein the light-emitting layer  
5 comprises the one or more double-spiro compounds having a light-emitting property.

81. The method of Claim 80, wherein the light-emitting layer further comprises one or more non-double-spiro light-emitting compounds.

82. The method of Claim 79, wherein the one or more layers  
10 comprises the double-spiro compound having one or more properties selected from the group consisting of visible light emission, electron transportation, electron injection, hole transportation, and hole injection.

83. A method of manufacturing the organic EL device of Claim 63, the method comprising:

15 providing a substrate;  
forming a first conductive layer;  
depositing the one or more chemical compounds comprising one or more of the double-spiro compounds so as to form the solid deposition comprising the light-emitting layer; and  
20 forming a second conductive layer, wherein either of the first and second conductive layers corresponds to the anode or cathode.

84. The method of Claim 83, wherein the formation of the light-emitting layer comprises depositing one or more of the double-spiro compounds having a light-emitting property.

25 85. The method of Claim 84, wherein the formation of the light-emitting layer comprises co-depositing one or more non-double-spiro light-emitting compounds.

86. The method of Claim 83, wherein the deposition of the one or more chemical compounds further comprises forming layers having one or more  
30 functions selected from the group consisting of visible light emission, electron transportation, electron injection, hole transportation, and hole injection.

87. The method of Claim 86, wherein the formation of the layers having one or more functions comprises depositing one or more of the double-spiro compounds.

88. The method of Claim 86, wherein the formation of the layers having one or more functions comprises depositing one or more non-double-spiro compounds.

1/6  
FIG.1

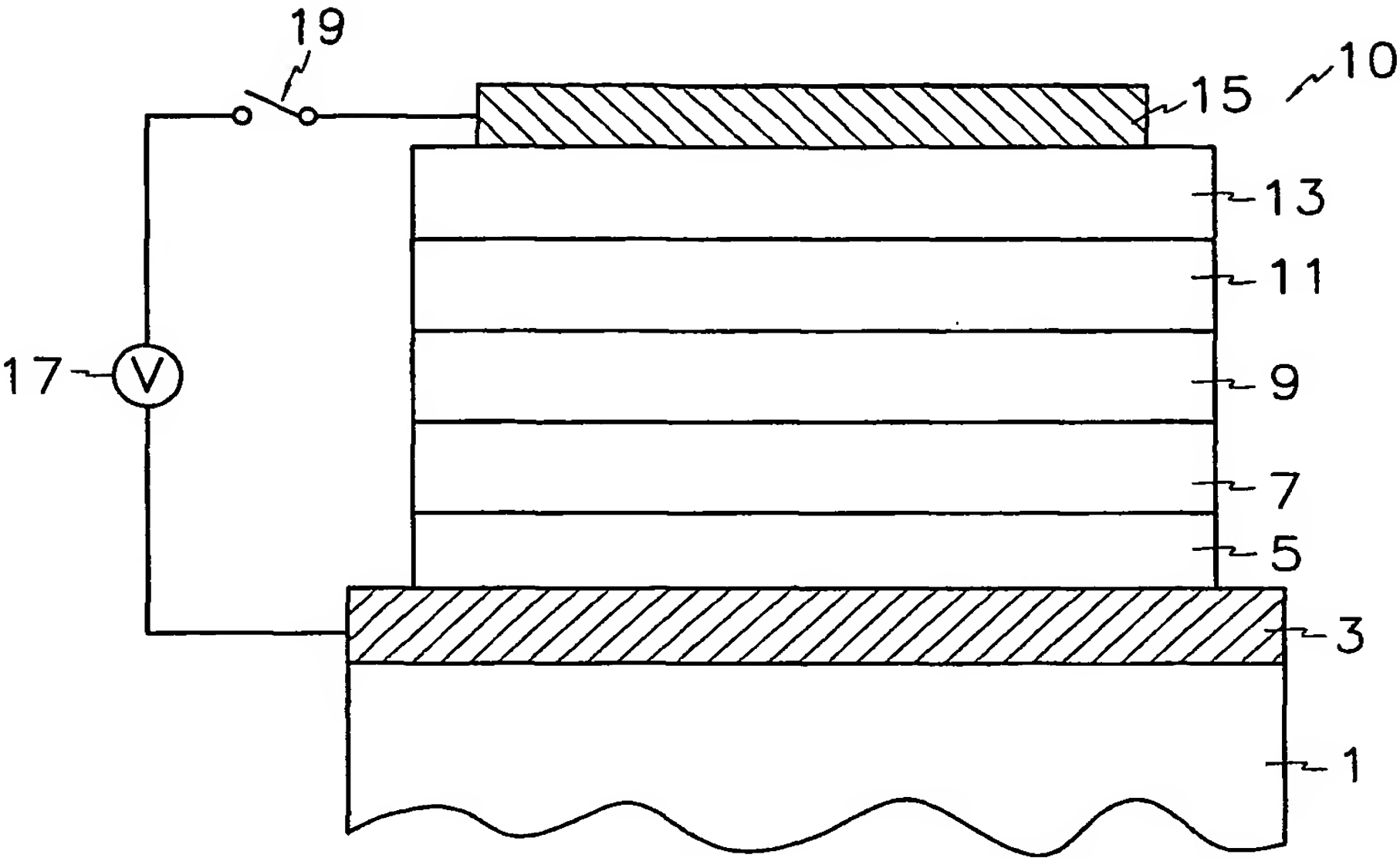
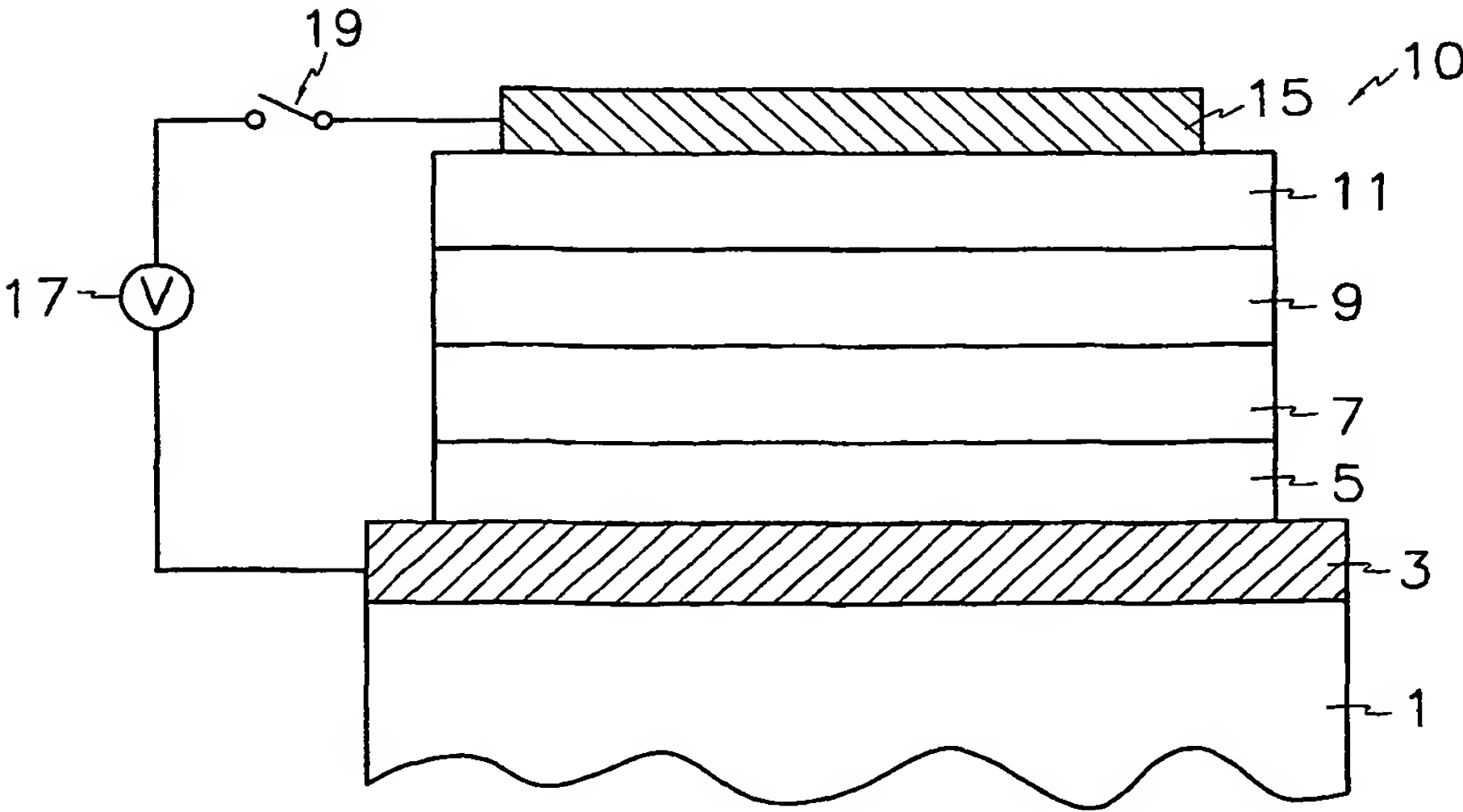


FIG.2



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FIG.3

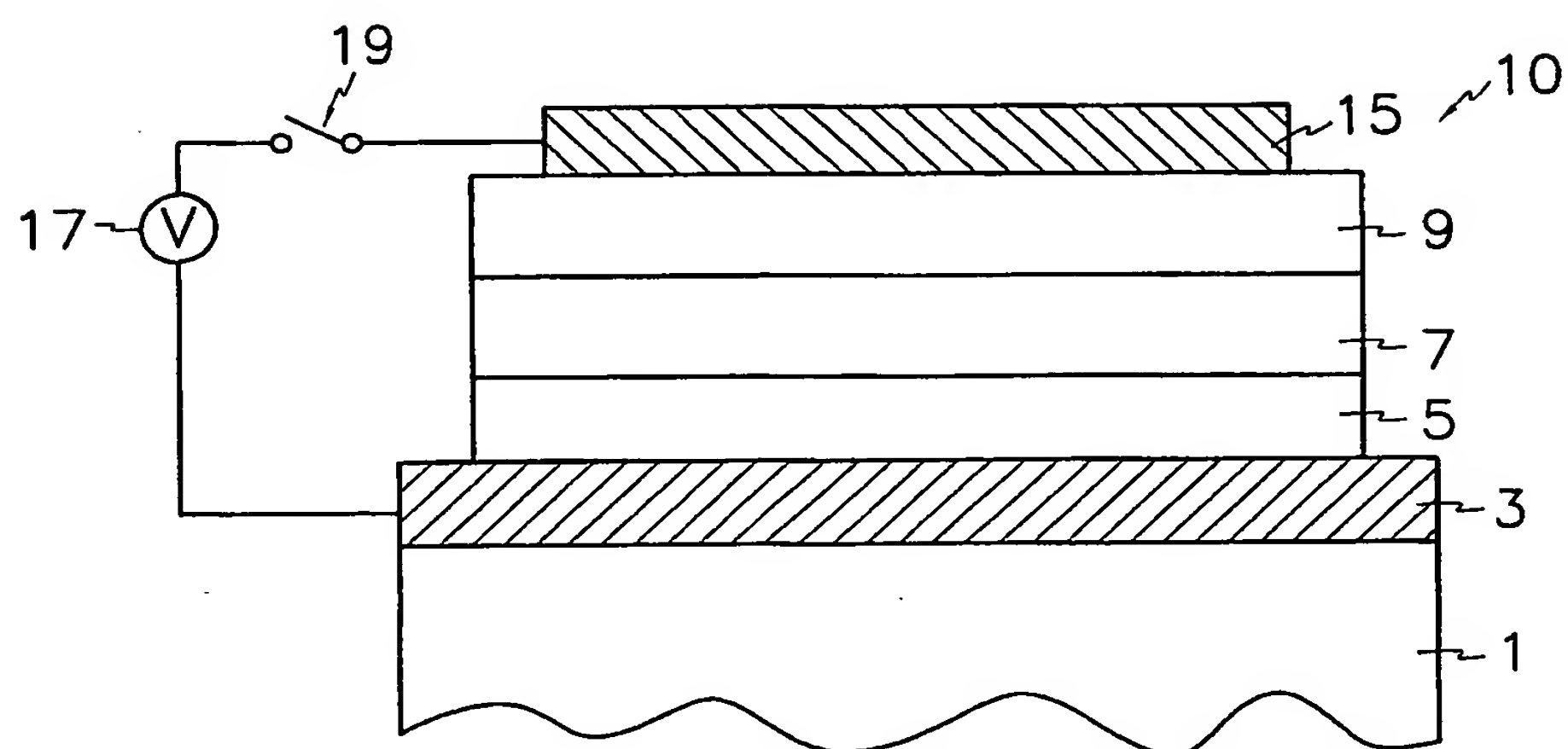
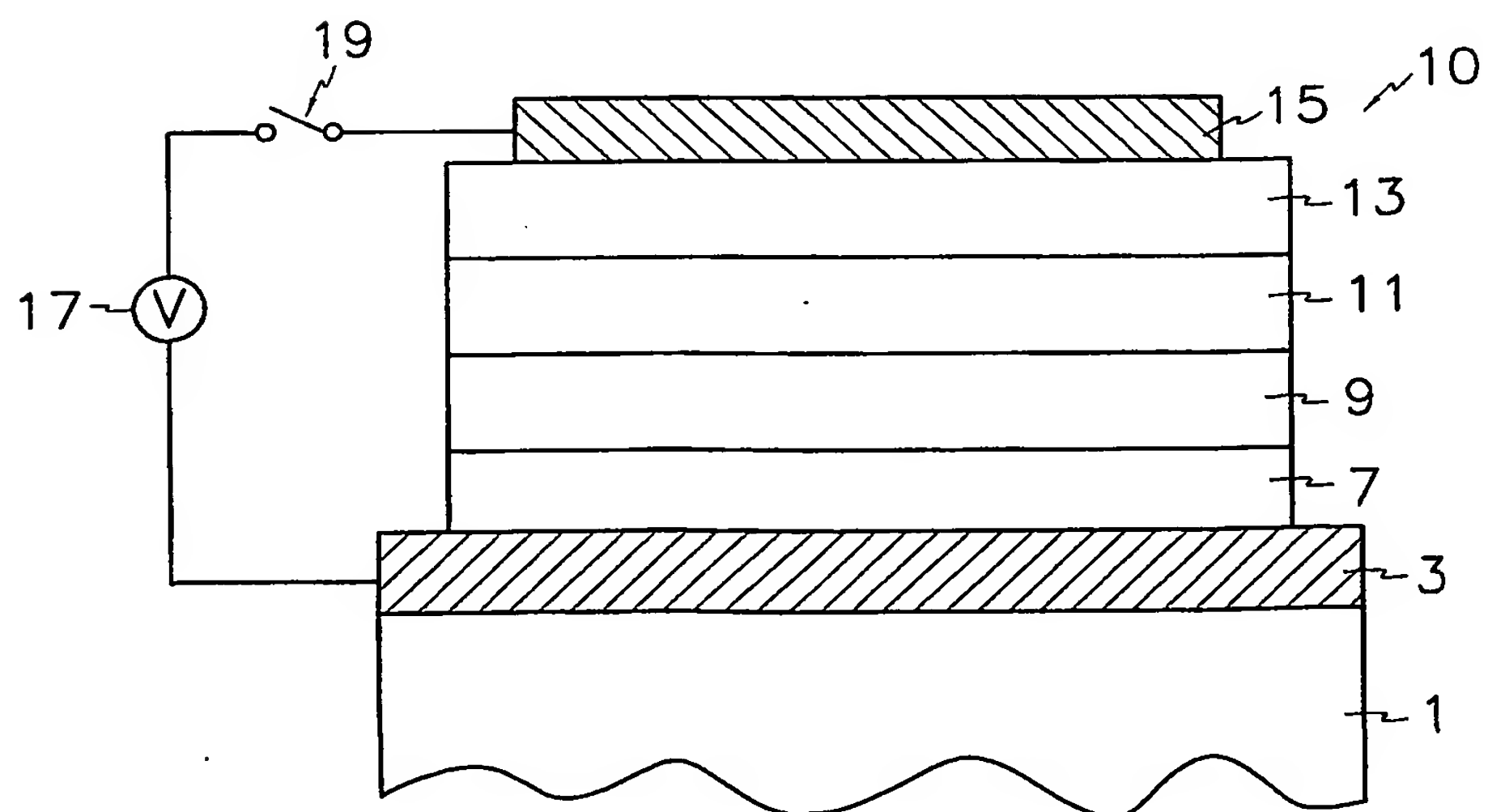


FIG.4



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FIG.5

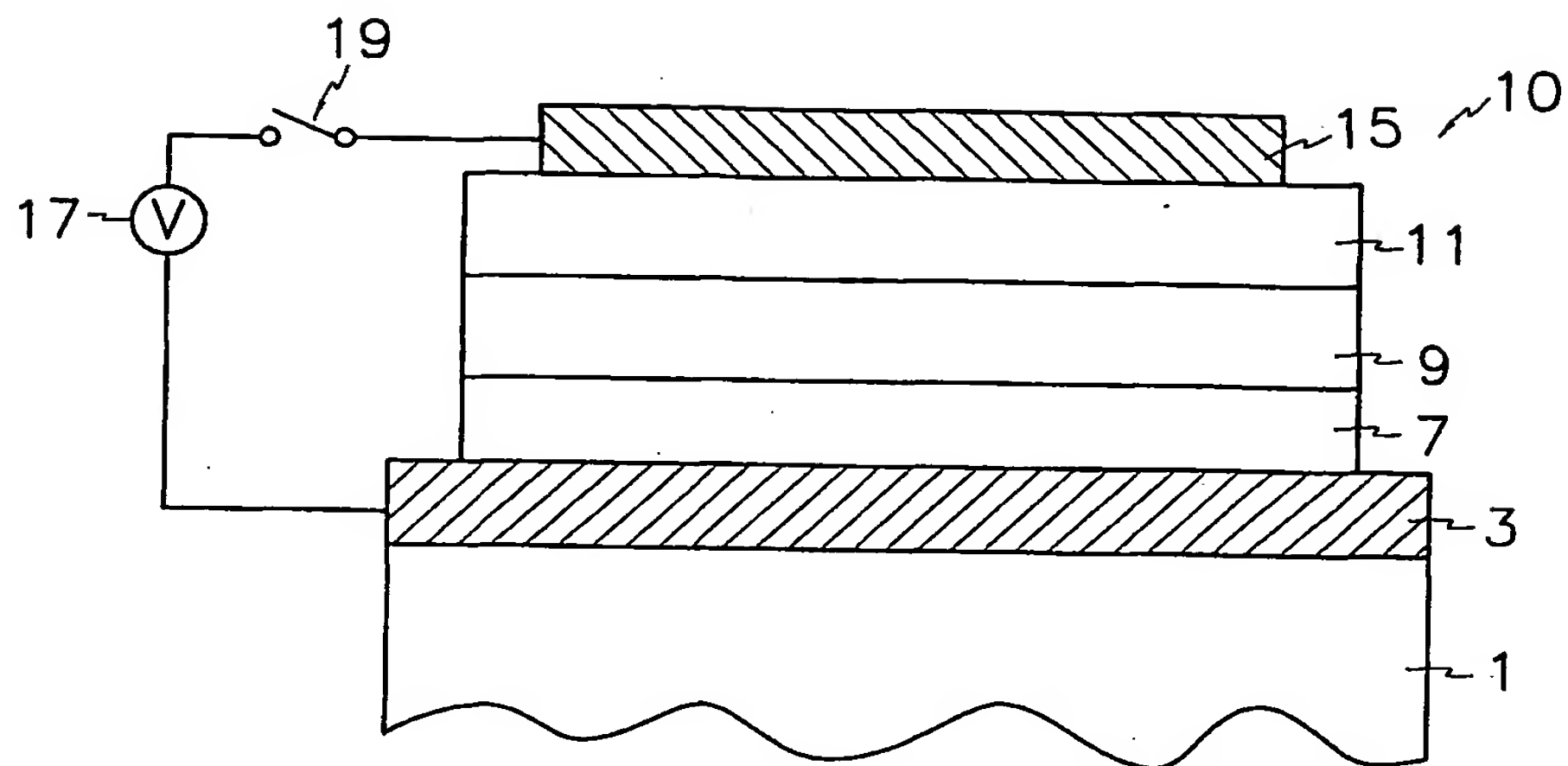


FIG.6

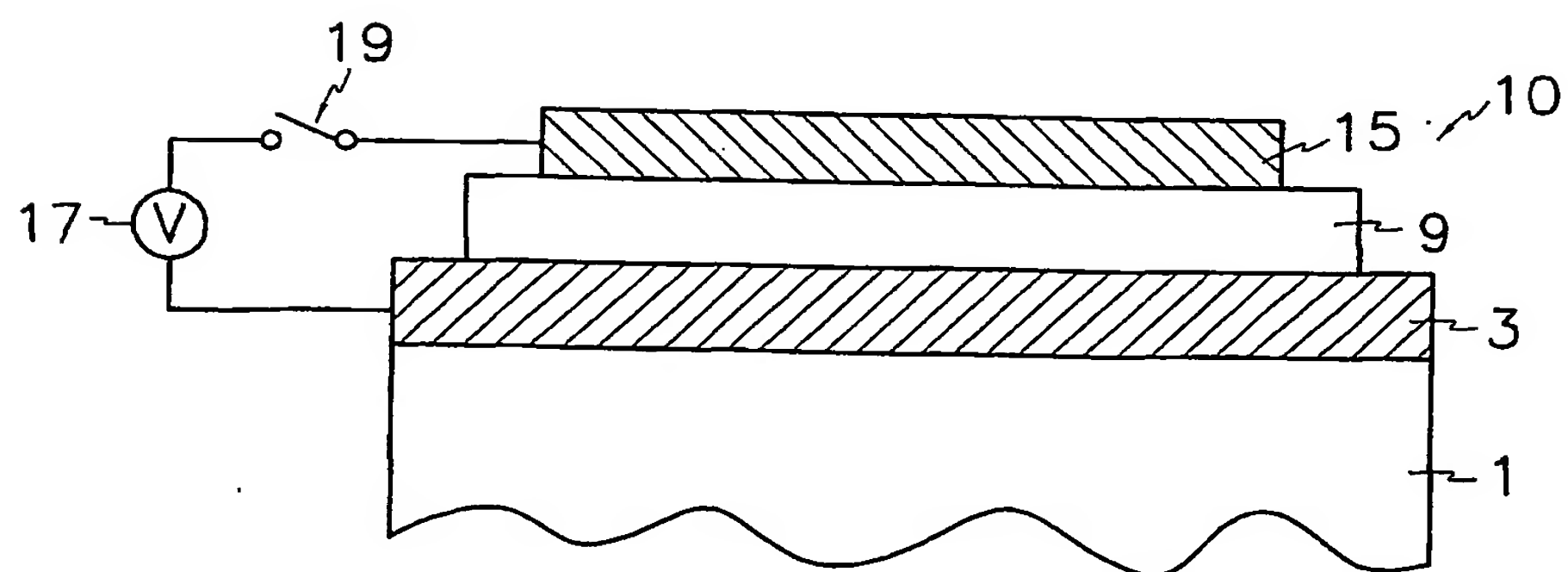


FIG. 7

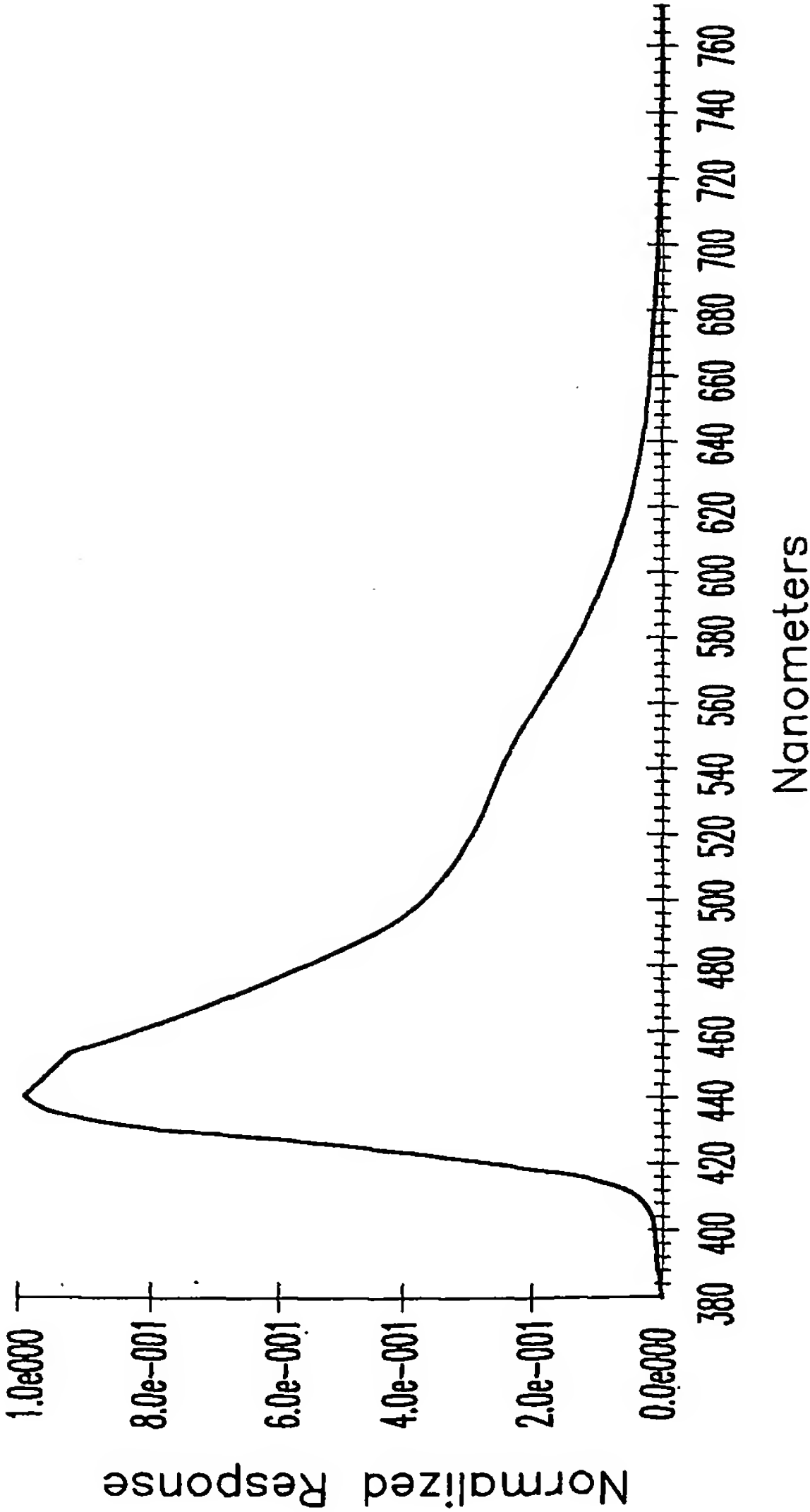
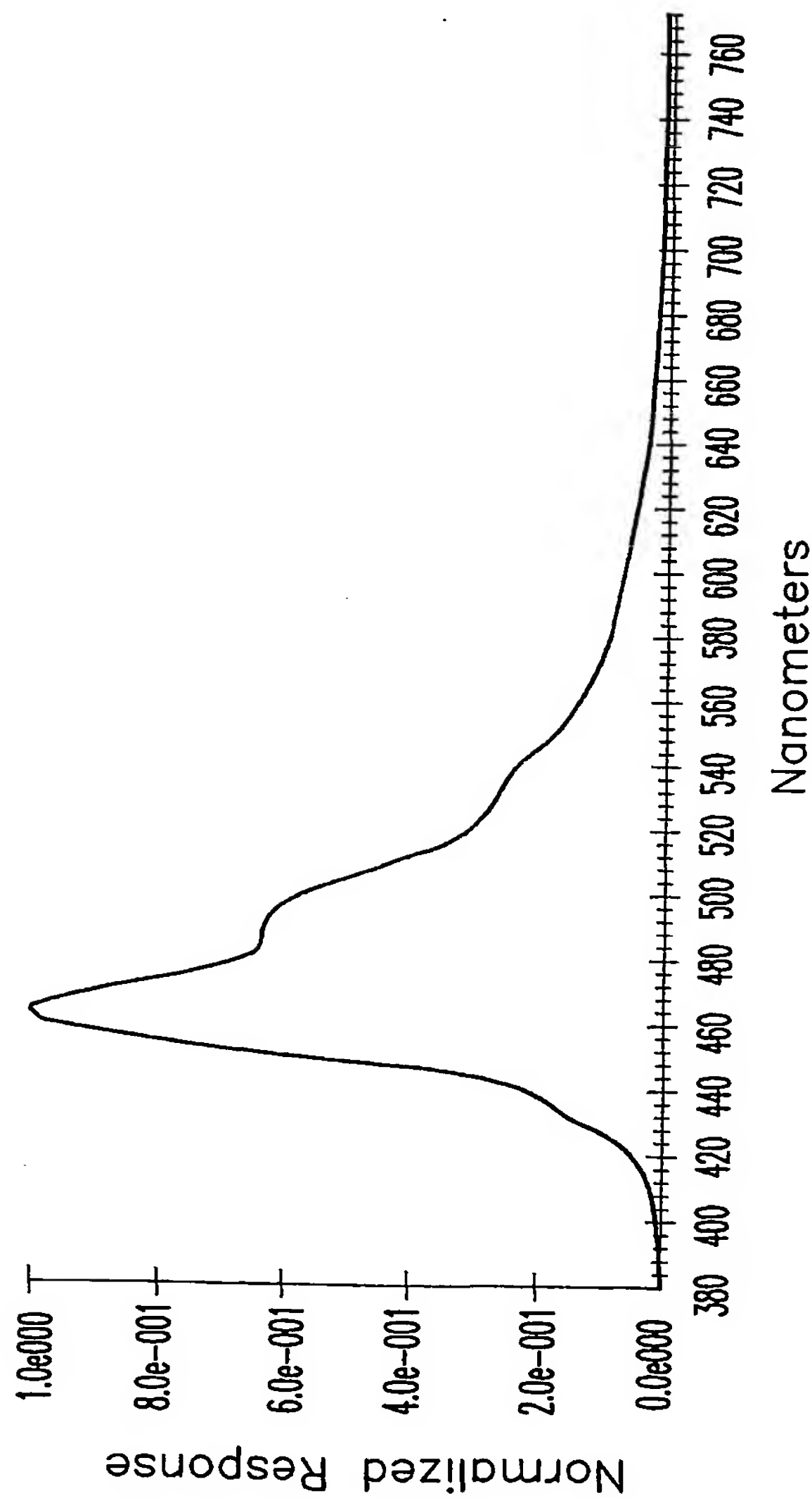


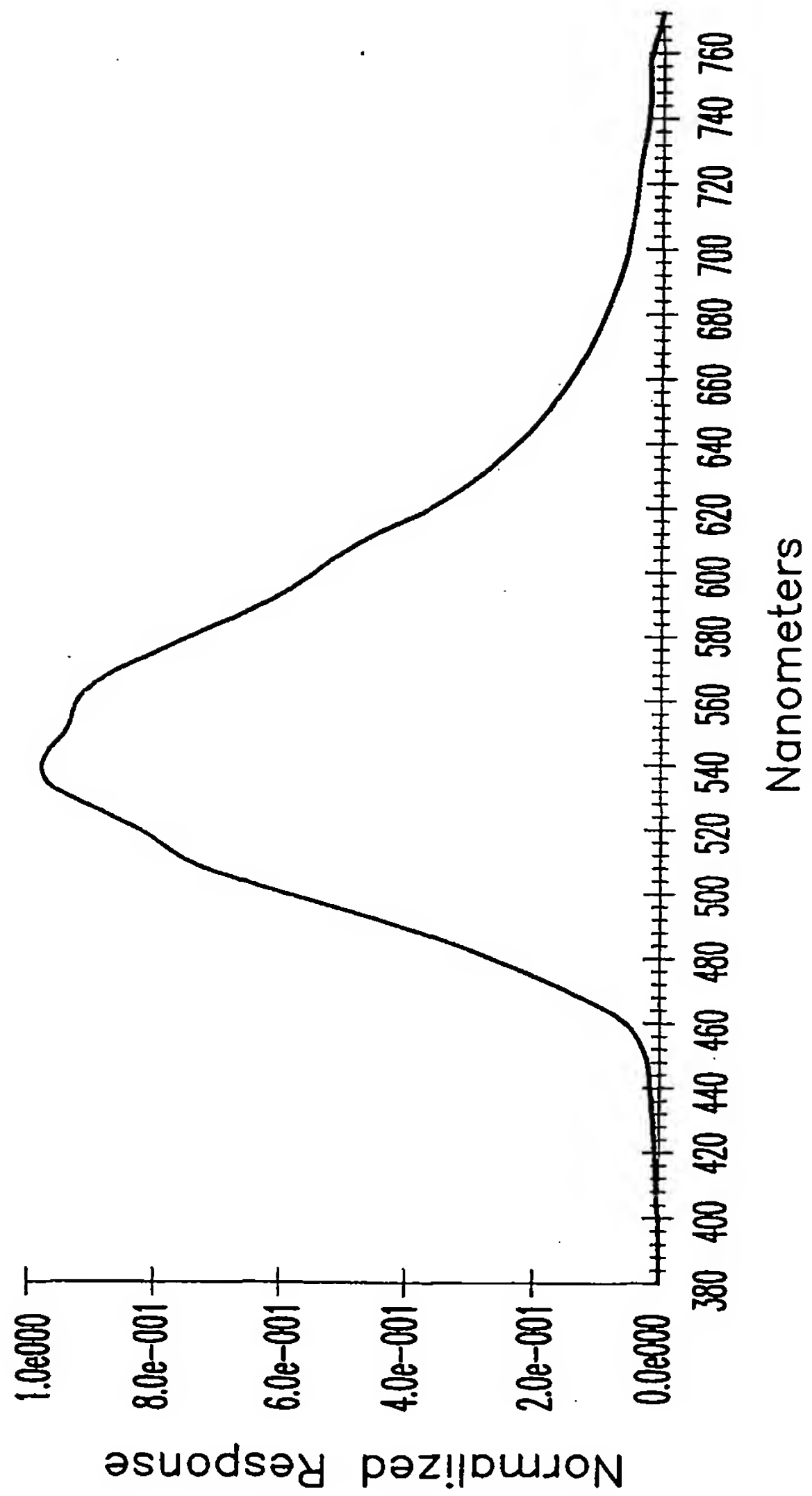
FIG.8





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FIG. 9



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/KR 02/00458

## CLASSIFICATION OF SUBJECT MATTER

IPC<sup>7</sup>: C09K 11/06, C07C 13/72

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC<sup>7</sup>: C09K, C07C 13/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 11 273863 A (TOYOTA CHUO KENKYUSHO KK) 8 October 1999 (08.10.99) <i>the whole document.</i>	1,25,27,29,60, 63,78,79,83
A	US 3869363 A (Singh) 4 March 1975 (04.03.75) <i>column 3, formula B; abstract.</i>	1
A	The Journal of the American Chemical Society, vol.LII, May-August 1930, R.G. CLARKSON et al. "Spirans with four aromatic radicals on the spiro carbon atom" pages 2881-2891. <i>page 2883, formula XI.</i>	1

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

## \* Special categories of cited documents:

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„T“ later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

„X“ document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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„&amp;“ document member of the same patent family

Date of the actual completion of the international search

18 April 2002 (18.04.2002)

Date of mailing of the international search report

10 June 2002 (10.06.2002)

Name and mailing address of the ISA/AT

Austrian Patent Office

Kohlmarkt 8-10; A-1014 Vienna

Facsimile No. 1/53424/535

Authorized officer

HAUSWIRTH

Telephone No. 1/53424/136

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.  
PCT/KR 02/00458-0

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
JP	A2	11273863	08-10-1999	none	
US	A	3869363	04-03-1975	none	

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